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CONTENTS

SYNOPSIS

Forty-six species, subspecies and varieties of mosquitoes have so far been found in the Arabian area. Five of these, *Anopheles demeilloni*, *Aëdes caballus* and *Culex arbieeni*, *duttoni* and *pipiens* var. *molestus*, are here recorded for the first time from the area. A small number of species previously recorded are considered to have been misidentified. The taxonomic position of a few others is reassessed. Keys to all the species are included and these have been extended to include three species of *Anopheles* which are not certainly known to occur in the area but may possibly do so. All available distribution records are included together with a list of the localities concerned and their approximate altitudes, latitudes and longitudes. The zoogeography of the fauna is discussed and the conclusion is reached that it is mainly Palaearctic with a very small Oriental element, largely confined to the coasts of the Persian Gulf and the Gulf of Oman, and a larger Ethiopian element confined to the south-western corner.

INTRODUCTION

Until recently our knowledge of the Arabian mosquitoes has been meagre in the extreme. Until the beginning of the second world war it was based mainly on small collections made many years ago in Oman, the Western Aden Protectorate and the island of Bahrein. Since that time, however, more abundant material has become available from the Eastern Aden Protectorate, Trucial Oman and the Yemen. Fortunately a number of representative specimens from the earlier collections have been preserved in the British Museum and the recent collections are well represented both there and in the United States National Museum. The London School of Hygiene also has an important collection. All these collections have been available to us for

study as well as a small but important collection from Socotra kindly lent to us by the Berlin University Museum. For the purpose of the present paper the Arabian area is arbitrarily defined as including the whole of the Arabian peninsula, south of Palestine, Sinai, Irak and Transjordan, together with the immediately adjacent islands and the island of Socotra. Records are available from all the principal political units involved, except Kuwait and Qatar. Despite this fact, however, the whole of northern and central Arabia remain virtually unknown to us. Most of the available records have been published previously, but four species and one variety, listed above in the synopsis, are here recorded for the first time. In view of the fact that three of the species concerned were collected, for the first time in Arabia, after work on the present paper was begun there can be little doubt that a number of other species remain to be discovered.

PROVISIONAL LIST OF SPECIES

The following list is provisional in the sense that the names which it includes are subject to the usual vicissitudes of taxonomic nomenclature and as such are liable to change as our knowledge increases. We are also of the opinion that the status of the Arabian form of any species should be not considered as finally established until the early stages and both sexes of adult are available. In many instances this is still not the case. The most we feel justified in claiming is that each form included in our list represents, to the best of our knowledge, a distinct and recognizable element in the Arabian fauna. In addition to this we have tried, as far as possible, to assess the taxonomic status of the forms concerned although it is clear that in certain cases insufficient material is available to permit any final conclusion to be reached.

Anopheles hyrcanus Pallas and *Anopheles subpictus* Grassi have both been recorded from Arabia, but we have omitted them from our list because we do not consider that their presence there has been conclusively established. Nevertheless both are known to occur in parts of Iran very close to the borders of our area and we have included them in our keys since it seems likely that both will eventually be found in eastern Arabia. Similarly we have included *Anopheles superpictus* in our keys since it seems almost certain that it will ultimately be found in northern Arabia. Unrecorded culicine species which we feel may yet be encountered are not included in our keys, but they are mentioned below under Zoogeography (p. 130). *Anopheles arabicus* Christophers & Chand, *Culex jenkinsi* Knight and *Culex arabicus* Becker have been synonymized by us with *Anopheles fluviatilis*, *Culex arbieeni* and *Aëdes caspius* respectively. *Anopheles theobaldi* Giles was recorded provisionally by Buxton (1944 : 212) but examination of the specimens in question has shown them to be *Anopheles pretoriensis*. It seems highly unlikely that *An. theobaldi* will be encountered in Arabia. From our recently acquired knowledge of variation in *An. dthali* in the Eastern Aden Protectorate it does not seem that var. *wardi* Leeson & Theodor (1948 : 222) is constantly distinguishable from the type form and we have provisionally discarded this name since it does not appear to us to serve any useful purpose. *Anopheles macmahoni* Evans was recorded from the Western Aden Protectorate by Buxton (1944 : 213) and Petrie & Seal (1943 : 63). We have seen the larvae in question

and consider them to be those of *An. sergenti* of which *An. macmahoni* is, in our view, a subspecies probably mainly confined to the African portion of the Somali-Arid District. The latter is therefore omitted from our list. *Culex thalassius* Theobald was recorded from Socotra by Leeson and Theodor (1948 : 228) but examination of the specimens concerned shows them to be *C. tritaeniorhynchus* and *C. sitiens*. We have no evidence of the occurrence of *C. thalassius* in the Arabian area and it is therefore omitted from our list. The following species and infraspecific forms are provisionally recognized by us as occurring in the Arabian area.

Genus ***ANOPHELES*** Meigen

1. *Anopheles* (*Anopheles*) *coustani* Laveran.
2. *Anopheles* (*Anopheles*) *coustani* var. *tenebrosus* Dönitz.
3. *Anopheles* (*Myzomyia*) *cinereus* Theobald.
4. *Anopheles* (*Myzomyia*) *culicifacies* Giles.
5. *Anopheles* (*Myzomyia*) *culicifacies* ssp. *adenensis* Christophers.
6. *Anopheles* (*Myzomyia*) *demeilloni* Evans.
7. *Anopheles* (*Myzomyia*) *dthali* Patton.
8. *Anopheles* (*Myzomyia*) *fluviatilis* James.
9. *Anopheles* (*Myzomyia*) *gambiae* Giles.
10. *Anopheles* (*Myzomyia*) *multicolor* Cambouliou.
11. *Anopheles* (*Myzomyia*) *pharoensis* Theobald.
12. *Anopheles* (*Myzomyia*) *pretoriensis* (Theobald).
13. *Anopheles* (*Myzomyia*) *pulcherrimus* Theobald.
14. *Anopheles* (*Myzomyia*) *rhodesiensis* ssp. *rupicolus* Lewis.
15. *Anopheles* (*Myzomyia*) *sergenti* Theobald.
16. *Anopheles* (*Myzomyia*) *stephensi* Liston.
17. *Anopheles* (*Myzomyia*) *turkhudi* Liston.

Genus ***CULISETA*** Felt

18. *Culiseta* (*Allotheobaldia*) *longiareolata* (Macquart).

Genus ***AËDES*** Meigen

19. *Aëdes* (*Ochlerotatus*) *caballus* Theobald.
20. *Aëdes* (*Ochlerotatus*) *caspius* Pallas.
21. *Aëdes* (*Stegomyia*) *aegypti* Linnaeus.
22. *Aëdes* (*Stegomyia*) *granti* Theobald.
23. *Aëdes* (*Stegomyia*) *vittatus* Bigot.
24. *Aëdes* (*Aëdimorphus*) *arabiensis* (Patton).
25. *Aëdes* (*Aëdimorphus*) *hirsutus* var. *adenensis* Edwards.
26. *Aëdes* (*Aëdimorphus*) *natronius* Edwards.

Genus ***CULEX*** Linnaeus

27. *Culex* (*Lutzia*) *tigripes* de Grandpré & de Charmoy.
28. *Culex* (*Neoculex*) *arbieeni* Salem.
29. *Culex* (*Neoculex*) *salisburiensis* Theobald.
30. *Culex* (? *Neoculex*) sp. indet.
31. *Culex* (*Culiciomyia*) *nebulosus* Theobald.
32. *Culex* (*Barraudius*) *pusillus* Macquart.
33. *Culex* (*Culex*) *decens* Theobald.
34. *Culex* (*Culex*) *duttoni* Theobald.
35. *Culex* (*Culex*) *ethiopicus* Edwards.
36. *Culex* (*Culex*) *laticinctus* Edwards.
37. *Culex* (*Culex*) *mattinglyi* Knight.
38. *Culex* (*Culex*) *pipiens* Linnaeus.
39. *Culex* (*Culex*) *pipiens* ssp. *fatigans* Wiedemann.
40. *Culex* (*Culex*) *pipiens* var. *molestus* Forskal.
41. *Culex* (*Culex*) *simpsoni* Theobald.
42. *Culex* (*Culex*) *sinaiticus* Kirkpatrick.
43. *Culex* (*Culex*) *sitiens* Wiedemann.
44. *Culex* (*Culex*) *theileri* Theobald.
45. *Culex* (*Culex*) *tritaeniorhynchus* Giles.
46. *Culex* (*Culex*) *univittatus* Theobald.

NOTES ON TAXONOMY

Anopheles coustani. Records by Leeson (1948 : 254) were based on larval material only and so could not be assigned as between the type form and varieties. However, adults from the same part of Arabia, in the U.S. National Museum, are var. *tenebrosus* and Leeson's records may therefore be provisionally assigned to this form. No other variety is known from eastern Arabia. The record from western Arabia can be attributed with certainty to the type form because it is based on a female adult. *Anopheles hyrcanus* was recorded from eastern Saudi Arabia (Hoffuf) by Leeson (1948 : 254), but this record was based only on one 4th stage and several earlier instar larvae. On the character of the inner shoulder hair, which has 4–5 branches arising from half way and beyond, the fourth stage larva resembles *An. hyrcanus*, but this character has been found to be unreliable (Lumsden, in Leeson *et al.*, 1950 : 81). The pecten has 10 long teeth and on this character, which has not previously been used for diagnosis but which works well in the material available to us, it resembles *An. coustani*. In our material *An. hyrcanus* has 9 long teeth at most (fig. 2*f*). The antennal shaft hair is very small and this also suggests *An. coustani* although it is not conclusive. On these characters and having regard to the specimens from adjacent areas an attribution to *An. coustani* var. *tenebrosus* seems more reasonable. As noted by Buxton (1944 : 211) the specimen from Dhufar is very worn, but we see no reason to question Evan's attribution to var. *tenebrosus*.

Anopheles hyrcanus. See above under *An. coustani*.

Anopheles cinereus. Leeson (1948 : 254) provisionally attributed one larva (from

among a batch of *An. multicolor* and *An. stephensi*) from Hoffuf to *An. cinereus*. We cannot accept this attribution since the larva in question has mouthbrushes of normal Anopheline type while those of *An. cinereus*, like those of *A. turkhudi*, are exceptional in that they project laterally from the clypeus in a manner reminiscent of the Culicini. Apart from the presence of three small rami on the anteroventral mesopleural bristle of one side (the mesopleural bristles of the other side are missing) this seems to be a typical larva of *An. multicolor*. We can feel no doubt that it is an aberrant larva of that species. It may be remarked that *An. culicifacies adenensis* and *An. dthali* are both on record as showing a similar aberration. De Meillon (1947 : 211) notes that, in general, South African *An. cinereus* have the third tarsal bands relatively broad while in East African specimens they are narrower. Specimens from Asir and the Western Aden Protectorate have the bands very inconspicuous, but in specimens from the Yemen they are distinct. Gill (1916 : 207) has a record of this species from Muscat, but states that it is open to question since only a partial description was available to him. We have been unable to ascertain the identity of the specimen in question since we have no specimens. Specimens may have been preserved in the Malaria Institute of India. The British Museum has one male and one female adult marked "Aden Hinterland, Lt. Patton ". One of us (P. F. M.) has marked the female as hololectotype and the male as allolectotype of *Anopheles jehafi* Patton. The possibility of confusion between *An. cinereus* and *An. hispaniola* in N.W. Saudi Arabia is discussed below (p. 130).

Anopheles culicifacies. This species was formerly on record from the Western Aden Protectorate (Christophers & Chand, 1915 : 186). Later Christophers (1924 : 296) distinguished the form in question as var. *adenensis*. Leeson & Theodor (1948 : 225) noted variation in one of the distinguishing characters described by Christophers and these authors retained the varietal rank. De Meillon (1947 : 100) accorded the Aden form specific status, but with considerable hesitation. Since the two forms appear to be geographically representative it has seemed more reasonable to us to treat them provisionally as subspecies. The record by Leeson (1948 : 254) from Oman suggests that the two forms may overlap there and that it would perhaps be the best area in which to study their relationship. De Meillon (1947 : 98) figures a larva of ssp. *adenensis* from Assab, Eritrea with one of the long mesopleural bristles split distally. We have no record of such an aberration in Arabian material, but we have allowed for it in our key.

Anopheles demeilloni. The present records are the first from Arabia. The record from W. Aden Protectorate is based on a unique female adult (in spirit, but in good condition) and some larvae. That from the Yemen is based on one female and two males, previously published as *An. fluviatilis* (Knight, 1953*b* : 220). Adults from both areas resemble the East African rather than the South African form in having the base of the costa entirely dark (see Evans, 1938 : 266 ; De Meillon, 1947 : 177).

Anopheles dthali. This was recorded fom Muscat and Aden as *An. rhodesiensis* by Christophers & Chand (1915 : 182) and Gill (1916 : 207). Conversely *An. rhodesiensis rupicolus* was reported from the Yemen as *An. dthali* by Buxton (1944 : 211). The two species are, however, easily separated on the character of the head scales and pharynx (Christophers & Puri, 1931*b* : 1133 ; Evans, 1938 : 249). Leeson & Thedor

(1948 : 222) distinguished the Socotra form as var. *wardi*. The characters which they studied appear to show random variation in material from the Eastern Aden Protectorate and we have therefore discarded the varietal name. Light feathering of the anteroventral mesopleural seta of one side only is recorded as an aberration by Puri (1931 : 147). and De Meillon (1947 : 109).

Anopheles fluviatilis. *Anopheles arabicus* Christophers & Chand (1915 : 189) appears to us to be synonymous with the present species. The principal difference between the two is the possibly more frequent occurrence in *An. arabicus* of a pale interruption in the basal dark area of the costa. However, Christophers and Chand (*loc. cit.*) noted the occurrence of such a pale interruption in about 5% of the Indian specimens of *An. fluviatilis* available to them while Ramakrishnan (quoted by Macan in Leeson *et al.*, 1950 : 211) found it in only 1–2% of his specimens of " *An. arabicus* " in southern Irak. The two Iranian specimens in the British Museum are intermediate, each having the interruption present on one wing only and reduced to 1–2 pale scales. We have not seen any larvae of *An. arabicus* but from the descriptions given by Christophers and Chand and by Christophers and Puri (1931*a* : 486) they appear to be indistinguishable from those of Indian *An. fluviatilis*. *An. fluviatilis* has been recorded from the Yemen (Knight, 1953*b* : 220), but it is now considered that the species in question was *An. demeilloni*. An. *fluviatilis* is unlikely to be found in western Arabia.

Anopheles gambiae. This was probably the species recorded as *An. subpictus* from the fortress of Aden by Phipson (1934 : 46) although, as far as is known, no material was preserved. The species is recorded as breeding in the smaller accessory (water) tanks and as being the only one found breeding in the fortress.

Anopheles multicolor. See above under *An. cinereus*.

Anopheles pretoriensis. Specimens from the Aden hinterland formerly placed under *An. theobaldi* in the British Museum and queried by Buxton (1944 : 212) are undoubtedly *An. pretoriensis*. They appear to be part of the original material of *Anopheles tibani* Patton (1905 : 629) and comprise one male and one female adult with the data " Arabia, Aden Hinterland, Capt. W. S. Patton ". These are the only specimens of *An. tibani* known to have been preserved. One of us (P. F. M.) has marked the female as hololectotype and the male as allolectotype of that species.

Anopheles rhodesiensis. De Meillon (1947 : 97) notes that it is doubtful whether this is specifically distinct from *An. rupicolus* Lewis. In our view it is not, and we have preferred to treat them provisionally as subspecies. A similar opinion has been expressed to one of us (P. F. M.) by Mr. Lewis. As previously noted (Knight, 1953*b* : 221) female adults from the Yemen would run to *An. rhodesiensis* on recent keys (De Meillon, 1947 : 21, 1949 : 467). They differ from the typical form of that species, however, in having only two well-marked spots on the costa. It is probable that the principal meeting place of the two forms is Abyssinia, from which there are numerous records (some still unpublished). Their relationship will be discussed more fully by one of us (P. F. M.) in a paper on the mosquitoes of Abyssinia which is at present in preparation. Larval differences between the two forms are not reliable (De Meillon, *loc. cit.*). Larvae from Wadi Duan have much darker heads than those from the Yemen (though still with the dark spots on the fronto-clypeus non-confluent and

relatively inconspicuous). They vary in the degree of development of the long spicules at the base of the antenna and the size of the tubercle at the base of the inner shoulder hair and are rather liable to be confused with those of *An. demeilloni* or *A. sergenti*. However, they can be recognised from the former by their fronto-clypeal markings and from the latter by their smaller tergal plates. The fact that this was the species published by Buxton (1944 : 211) as *An. dthali* from Ta'izz has been established by examination of a slide of the female pharynx and another of the male terminalia preserved at the London School of Hygiene and is confirmed by the subsequent discovery of *An. rhodesiensis rupicolus* in the same locality (Knight, 1953*b* : 221). Earlier confusion between the two species has been noted above under *An. dthali*.

Anopheles sergenti. This species and *Anopheles macmahoni* Evans (1936 : 538) are so closely similar that in our view they should be treated as subspecies. Aside from the variable characters in wing and larva mentioned below, the principal difference is in the female pharynx. In the type form of *An. sergenti* (from Algeria and Transjordan) the central processes on the post-pharyngeal ridges are short and very delicate, while the rods taper uniformly to form long, delicate terminal filaments. The only female of *An. macmahoni* at present available to us is a paratype in the British Museum and we are unwilling to dissect this. It is, however, perfectly clear from the description and figure of *An. macmahoni* given by De Meillon (1947 : 187 and plate 66) that in this form the median processes on the first row of post-pharyngeal ridges are much longer and stouter, while the rods lack the terminal filament or have only a very short one. Arabian specimens (from Jeddah and Tarim) are intermediate with respect to the terminal filaments of the rods, which are short and somewhat asymmetrical, while the median processes on the post-pharyngeal ridges are considerably shorter and more delicate than in *An. macmahoni*. (In the specimen from Jeddah they are somewhat longer and stouter than in specimens from Tarim, which more or less resemble type form *sergenti*). In our view these pharyngeal differences would not justify us in distinguishing *An. macmahoni* as a subspecies since there is clear evidence of intergrading. The latter differs sharply from *An. sergenti*, however, in the condition of the third vein of the wing. This is constantly dark except at base and extreme tip over the wide range of specimens of *An. sergenti* available to us (Christophers, 1933 : 195, mentions " an indistinct palish area about middle " as being sometimes shown), whereas in *An. macmahoni* it appears that it is normally extensively pale scaled in the middle and only exceptionally dark. De Meillon shows the 4th vein of *An. macmahoni* as pale, but it is exactly as in *An. sergenti* in our paratypes. The larva of ssp. *macmahoni* is much more variable than that of *An. sergenti* with respect to the tergal plates. Evans (1938 : 290) states that on segment V of the abdomen their width varies from about three-quarters of the distance between the palmate hairs to about equal to this distance and that the anterior accessory tergal plate may sometimes be partly included in the posterior border of the main tergal plate, while Giaquinto-Mira (1950 : 294) describes a form from Abyssinia (" var. *barkhuusi* ") in which the tergal plates may be even wider and the anterior accessory plate is completely enclosed in the main plate. In our view these variations, none of which are known to occur in *An. sergenti* s.str., in which the

maximum width of the tergal plates on segment V is about four-fifths of the distance between the palmate hairs, justify us in maintaining *An. macmahoni* as a subspecies. It is apparently entirely confined to the African portion of the Somali Arid District and certain mountains in the southern Anglo-Egyptian Sudan. Since it is not known to occur in Arabia we have omitted it from our keys, Should it occur then larvae might be liable to confusion with those of *An. fluviatilis*, to which they would run on our key. They could, however, at once be distinguished by the branched anteroventral mesopleural hair. Adults might be inseparable from those of *An. adenensis* and it would be as well to confirm records of this species from larvae wherever possible. Slight variation occurs in the markings of legs and male palps in *An. sergenti* (Knight, 1953*b* : 223), but it appears to have no taxonomic significance. Variation in the larva is more pronounced. Most larvae from the Aden Protectorate have the accessory tergal plates suppressed, a feature also observed in larvae from Iran and Palestine and noted by Puri (1931 : 167) for larvae from Waziristan. Buxton (1944 : 213) and Petrie & Seal (1943 : 63) recorded larvae of " *An. macmahoni*" from the Western Aden Protectorate, but these larvae show no difference from others of the type form, to which we have therefore assigned them. Variation in larval head markings is shown as between specimens from Tarim and Shibam and those from Wadi Natid respectively but this falls within the range described by Saliternik (1955) in Palestine and is probably associated with variation in background colour in the breeding places.

Anopheles subpictus. See above under *An. gambiae.*

Anopheles superpictus. As already noted, this species has not been recorded from Arabia. It has, however, been found in Transjordan and in southern Irak and may well occur in the northern part of our area. In view of its importance as a malaria vector it has been thought desirable to include it in our keys.

Anopheles turkhudi. Evans (1938 : 249) notes the possibility that males of this species may be confused with those of *An. dthali* or *An. rhodesiensis.* It may also be noted that several of the characters which she herself lists as diagnostic from *An. cinereus* are variable in the latter species. The possibility of confusion between this species and *An. hispaniola* in N.W. Saudi Arabia is discussed below (p. 130).

Culiseta longiareolata. Edwards (1941 : 69) noted two types of variation as broadly characteristic of Mediterranean (and Somali Arid) and South African specimens respectively. As previously noted by one of us (Knight, 1953*b* : 224), however, nearly the whole range of variation is shown by specimens from the Yemen.

Aëdes caballus. The records given below are based on four female adults, and as they are the first from Arabia they require confirmation. So far as can be seen, however, the specimens seem typical and the distribution is certainly a very likely one.

Aëdes caspius. The record from Hoffuf is a conjectural one based on the data label of the slide of " *Anopheles* ? *cinereus* " discussed above. This label states that the specimen in question was found together with *An. multicolor, An. stephensi, Cu. pipiens* and " *Aëdes mariae* ". We have no record of the last named from Arabia or from anywhere near the boundaries of our area. In view of the close resemblance of its larva to that of *Aëdes caspius* and the fact that the latter has been found in the

same general area the present attribution seems a reasonable one. Edwards (1921 : 299, 1932 : 141) placed *Culex arabicus* Becker, from Socotra, in the synonymy of *Aëdes caspius*. Later, however, (1941 : 353) he preferred to treat it as a species of uncertain position by reason of its simple hind tarsal claws. Examination of the type

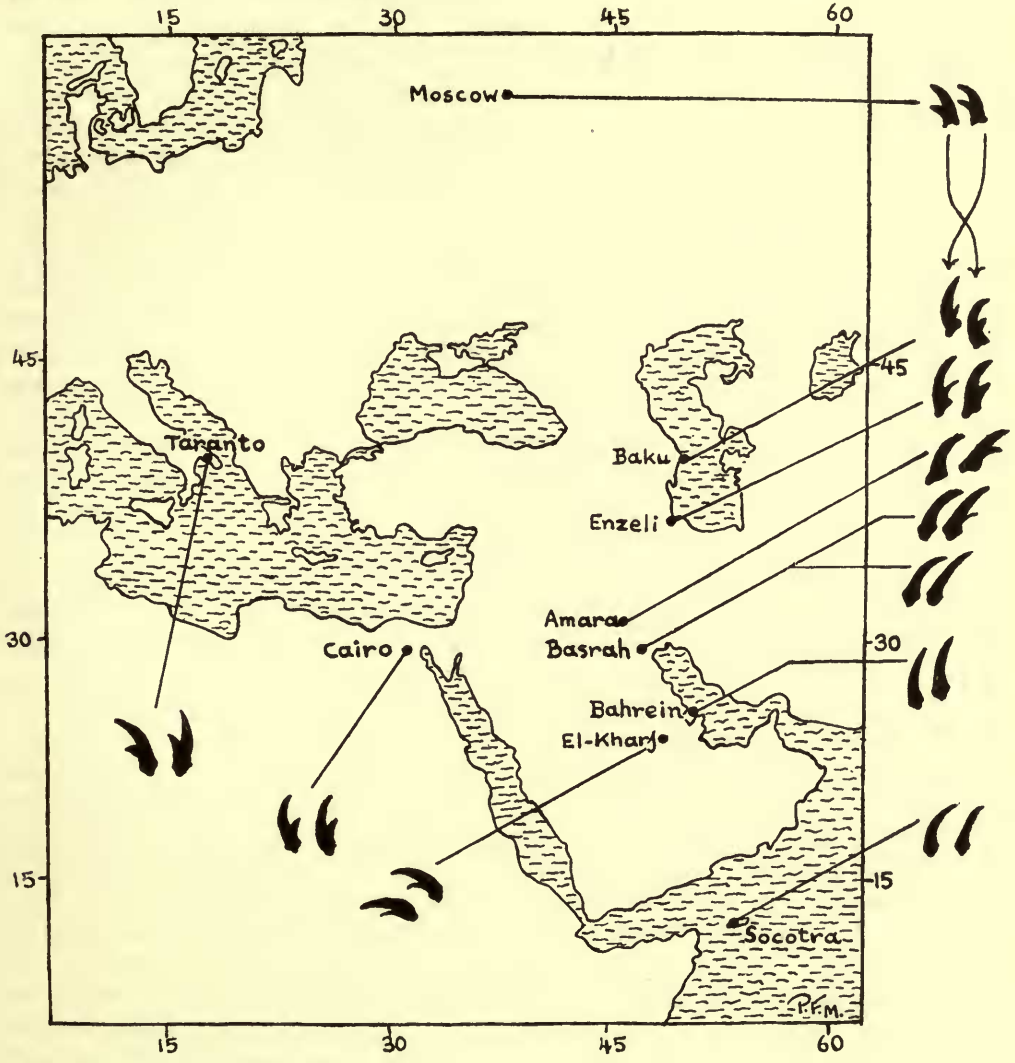

FIG. 1.—Clinal variation in female hind claws of *Aëdes caspius*.

of *Cu. arabicus*, kindly loaned to us by Professor Peus of the Berlin Museum, shows that in other characters it resembles *Aëdes caspius* while examination of a number of specimens of the latter from various parts of its range shows that variation in the hind claws is continuous and apparently clinal (Text-fig. 1.). Specimens from the Mediterranean area (Italy, Macedonia, Palestine, Egypt) have both hind claws strongly

toothed. Others from the area of the type locality (Caspian Sea) have both claws toothed, but the tooth on one of them is markedly reduced. A specimen from Amara, Irak, has this claw entirely simple, the other still being strongly toothed. In specimens from Basrah one claw is simple and the tooth on the other is either greatly reduced or absent. All specimens from the Arabian area examined by us show the extreme degree of reduction with both claws entirely simple except that an inland specimen from El-Kharj (about 1,000 ft.) has both claws with delicate teeth, suggesting that a temperature effect is involved. Since this variation is apparently continuous it does not seem to us worth while preserving the name *arabicus*. Should it later seem desirable to do so we may point out that the name is, in any case, preoccupied for *Aëdes* by *Mansonia arabica* Giles (1906 : 130), which was applied to the form of *Aë. caspius* occurring on Bahrein.

Aëdes aegypti. Two forms of this species occur in the Arabian area, a pale form and a dark form. They interbreed readily in the laboratory, and from the fact that numerous intermediates are found wherever they occur together it seems certain that they also interbreed in nature. Their distribution and bionomics are discussed below under Zoogeography (p. 135). Edwards (1941 : 476) lists the pale form under the name " var. *queenslandensis* Theobald ", but this is not legitimate since it is clear from the facts of distribution and from Linnaeus' original description that the pale form is in fact the type form. Although they have been introduced into many parts of the world by Man both forms show a marked reluctance to spread beyond their point of introduction (Mattingly, 1953*a* : 46 ; Reid, 1954 : 164) and their relative distribution in any given area can therefore be mapped with reasonable accuracy. Thus it appears reasonable to name them as subspecies, and study of their distribution on a world basis is being made with this end in view. This is, however, still not completed and for the purposes of the present paper both are referred to under the name " *Aëdes aegypti* ". The two forms show certain interesting biological differences which are discussed below (p. 136).

Aëdes granti. The taxonomic position of this remarkable species has been discussed by Mattingly (1953*b* : 17) and Marks (1954 : 353). It is intermediate in its characters between the *Aëdes scutellaris* Walker and *Aëdes albopictus* Skuse groups of *Stegomyia*. The male terminalia were recently figured for the first time by Mattingly (1954 : 268). The type locality (Dahamis Glen, i.e. Wadi Dahamis) has not been published before. It is recorded on the data label of the type and is described by Forbes (1903 : xxxvi).

Aëdes vittatus. Unassociated larvae from Awabil, provisionally ascribed to this species, have an unusually number of bifid or even, occasionally, trifid comb spines (Text-fig. 3*a* shows an extreme example). A similar aberration is known from other parts of the range (e.g. the Anglo-Egyptian Sudan) though to a much smaller extent. This is an interesting convergence towards *Aë. hirsutus* and might cause confusion were it not that the latter has head seta 6 (C) multibranched. In *Aë. vittatus* this seta is usually plumose (*pace* Hopkins, 1952 : 160, who describes it as simple). The larva ascribed by Hopkins (1952 : 178) to *Aë. minutus* Theobald and others similarly attributed by one of us (P. F. M.) in a footnote to Hopkins' description are in fact *Aë. vittatus*. The true larva of *Aë. minutus* has been found by Mr. Muspratt in South Africa and is quite different. The character of the entirely smooth antenna used by

Hopkins (1952 : 117) for keying "*Aë. minutus*" is now known to occur also in *Aë. vittatus*.

Aëdes arabiensis. This is very closely related to the holarctic, Oriental and Australasian *Aë. vexans* Meigen, of which it is possibly no more than a subspecies (see Edwards, 1941 : 195).

Aëdes hirsutus var. adenensis. The description of the type series by Edwards (1941 : 198) is incorrect. It consists of 2 ♀ from about 7,100 ft. on Jebel Jehaf and 1 ♂ and 7 ♀ from Dhala (Dthala). One of us (Mattingly, 1955*c*) has recently marked a Jebel Jehaf specimen as hololectotype. Edwards did not describe the male terminalia. They are indistinguishable from those of the type form.

Aëdes natronius. Previous descriptions by Edwards (1941 : 199) and Hopkins (1952 : 205) are misleading (see Knight, 1953*b* : 224).

Culex tigripes. We have seen specimens from all the localities listed below and all resemble variant 5 of Edwards (1941 : 249).

Culex arbieeni. The Yemen adults were described by Knight (1953*a* : 323) as *C. jenkinsi* sp. n. The larva provisionally attributed to the latter (Knight, 1953*b* : 225) is quite unlike that of *C. arbieeni* and is here treated as "*Culex* sp. indet." The synonymy of *C. arbieeni* is discussed in detail by Mattingly (1955*b* : 381).

Culex salisburiensis. The discription of the male terminalia by Edwards (1941 : 258 and fig. 83*a*) is misleading. They were redescribed by Knight (1953*b* : 226 and fig. 2). The Yemen specimens are of the type form. Var. *capensis* De Meillon (1935 : 354) was not recognized by Edwards but it is almost certainly a good subspecies. The close resemblance of this species to *Culex deserticola* Kirkpatrick requires emphasis, as the latter may well be found in northern Arabia.

Culex (? *Neoculex*) sp. indet. The larva of this species was provisionally attributed by Knight (1953*b* : 225) to *Culex jenkinsi*. As noted above, this species is now known to be synonymous with *Culex arbieeni* which has a highly characteristic larva quite different from the present one (see Hopkins, 1952 : 251 and fig. 142). The present larva differs in important respects from all the known Palaearctic and Ethiopian larvae of the genus *Culex*. The characteristics of the head setae, siphon and pecten teeth suggest that it may be a *Neoculex* though this is uncertain. Many of the Ethiopian *Neoculex* have unknown larvae as does a Palaearctic species from Baluchistan recently described by one of us (Mattingly, 1955*b*). The identity of the present species must therefore remain uncertain until adults with associated larval skins can be obtained.

Culex pusillus. This species, so far as is known, is entirely confined to the Mediterranean subregion. It is placed in a distinct subgenus together with *Culex modestus* Ficalbi, which has a more northerly distribution and is, perhaps, not very likely to be found in Arabia. The resemblances between this small subgenus and *Lutzia*, noted by Edwards (1921 : 332), are interesting.

Culex nebulosus. The only Arabian record of this very common peridomestic Ethiopian species is based on a unique male adult intermediate in its characters between *C. nebulosus* s.str. and *C. nebulosus* var. *pseudocinereus* Theobald (see Knight, 1953*b* : 228).

Culex duttoni. This is another very common peridomestic species on the African

mainland. The only record from Arabia is based on two whole larvae and it requiers confirmation, since these larvae are apparently indistinguishable from those of *Culex watti* Edwards. The attribution to *C. duttoni* is based mainly on the fact that it seems to be very much the commoner of the two species, but this impression may be due in part to the fact that *C. watti* has only recently been recognized as a distinct species (Edwards, 1941 : 302) and it is very desirable that records should be confirmed wherever possible by breeding out. The affinities of *C. duttoni* and *C. watti* have until recently been very obscure, but the recent descovery by Mr. Donald Colless of the larva of *Culex hutchinsoni* Barraud reveals that this species is closely related to them. There are also striking resemblances in the male terminalia. *C. hutchinsoni* is known only from Assam and Malaya.

Culex laticinctus. Specimens from San'a and Dhahran published by Edwards (1941 : 314) under this name proved on dissection of the male terminalia to be *Culex mattinglyi.* Specimens from Ta'izz and Hadibo have prealar scales (except as a rule in the male). The same is true of most Mediterranean specimens, although our series from Muscat lacks them. Ethiopian specimens from the African mainland seem generally to lack them (Edwards, 1941 : 313) and it seems that a temperature effect may be involved.

Culex mattinglyi. See above under *C. laticinctus.*

Culex pipiens. The MS. record from Hoffuf is based on the data label of the slide of "*Anopheles cinereus*" discussed above under that species and *Aëdes caspius.* The status of the form here referred to as ssp. *fatigans* (*quinquefasciatus* Say of many authors) is the subject of some disagreement. The subspecific status has been conferred by reason of the fact that this and the type form cross readily in the laboratory and that attempts to demonstrate any natural barrier to hybridization have so far failed (Rozeboom in Mattingly *et al.*, 1951 : 343). The distribution of intermediate forms (? hybrids) has been the subject of a recent study by Dr. A. R. Barr of the University of Minnesota, the results of which are, it is understood, to be published shortly. In the interim it seems desirable to point out a fact which has hitherto escaped comment and this is that a number of recent publications on North American mosquitoes show figures of the male terminalia of "*Culex pipiens*" which are, in fact, intermediate between those of *C. pipiens pipiens* and *C. pipiens fatigans* and seem indistinguishable from those of F_1 laboratory hybrids. Good examples are Yamaguti & LaCasse (1951 : 46, plate XV) and Carpenter *et al.*, (1946 : 246, fig. 135). It cannot therefore be doubted that there exist in the southern United States a naturally occurring form or forms morphologically indistinguishable from *C. pipiens-fatigans* hybrids. The only other part of the world where this is known to be the case is the Sino-Japanese area. The intermediate form occurring there is known as *C. pipiens* var. *pallens* Coquillett. That the form occurring in the southern United States is either an introduced or a relict *C. pipiens* var. *pallens* is possible, but that such a form could exist side by side with *C. pipiens pipiens, C. p. var. molestus* and *C. p. fatigans* without hybridization taking place seems improbable. This is especially so in view of the natural hybridization between *C. pipiens* var. *molestus* and *C. p. fatigans* which followed on the recent introduction of the former into southern Australia (Drummond in Mattingly *et al.*, 1951 : 369). No forms which are clearly of

the hybrid type have as yet been found in either the Ethiopian Region or the Mediterranean Subregion but the material available from areas where the ranges of *C. pipiens* and ssp. *fatigans* overlap is at present very scanty. In Arabia var. *molestus* and ssp. *fatigans* appear to occur together in the Jedda area and the same applies to the type form and ssp. *fatigans* in Trucial Oman. These might therefore be good areas in which to study the problem.

The status of *C. pipiens* var. *molestus* has also been the subject of controversy. Although differing morphologically and biologically from other forms it crosses readily, at least with ssp. *fatigans*. Its biological characteristics are not constant and it appears to intergrade with the type form with respect to morphological characters in the Mediterranean area (Edwards, 1921 : 346) and the Anglo-Egyptian Sudan Lewis, 1945 : 17). The British Museum has a series of male adults from Jedda which agree with var. *molestus* in their very pale colour and short palps (from 0·9 to just over 1·0 times the length of the proboscis, including labellum). On the basis of these specimens we feel justified in provisionally including var. *molestus* in the Arabian list. This variety appears to be the dominant form around the shores of the Mediterranean (where it is sometimes referred to as var. *berbericus* Roubaud or var. *autogenicus* Roubaud), although the type form also occurs there sporadically and probably replaces it entirely at high altitude. The taxonomic status of the various members of the *Culex pipiens* complex has been discussed by Mattingly *et al.* (1951) and Knight and Abdel Malek (1951) have given a full account of the morphological and biological characteristics of a topotypical form of *C. pipiens* var. *molestus* from Cairo.

Culex simpsoni. The description of the larva by Hopkins (1952 : 293) is misleading (see Mattingly & Brown, 1955 : 85 and 105). The principal diagnostic character from *Culex sinaiticus* is provided by the relative length of the pecten. It is possible that in parts of the joint range of the two species this character may prove unreliable, but the pecten is perceptibly shorter in *C. simpsoni* in all the material available to us. Characters for the separation of the adults of these species used by Edwards (1941 : 286) have also proved unreliable and it seems that in S.W. Arabia they are inseparable on external characters. This point is further discussed, under *C. sinaiticus*, below.

Culex sinaiticus. Adults of both sexes from the Eastern and Western Aden Protectorates and from Socotra have dark as well as light scales on the front coxae and relatively extensive dark scaling at the apices of some of the posterior abdominal sternites. Their scutal ornamentation is closely similar to that of *Culex simpsoni* from the Yemen. In this area, therefore, the two species cannot be separated on the characters used by Edwards (1941 : 286) in his key and they appear to be distinguishable only on the characters of the male palps and terminalia. The unique male from Muscat in the British Museum, which is our only specimen from Oman, runs down satisfactorily on Edwards' key and the same seems likely to be true of other *C. sinaiticus* from the northern and eastern parts of Arabia, although more material would be necessary to confirm this and to justify us in naming the darker form as a subspecies.

Culex sitiens. Although *Culex annulus* Theobald is usually regarded as a synonym of *Culex tritaeniorhynchus*, the specimens from Socotra published by Becker (1931 :

140) under the former name are *C. sitiens*. The series in question was kindly loaned to us by Prof. Peus of the Berlin Museum. For a full description of the larva see Knight (1953*b* : 231). Yemen larvae differ from those from an unnamed locality in the Red Sea area keyed by Hopkins (1952 : 248) in having a more extensive pecten, more numerous comb scales (41–58), shorter saddle hair and longer anal papillae. The male terminalia of the Yemen form resemble those figured by Edwards (1941 : 297, fig. 102, *b*, *c*) for the form associated with Hopkins' larvae. The adults also resemble this form in the pale background scaling of the mesonotum. Specimens from Jedda and the Eastern Aden Protectorate resemble the Yemen form in coloration. Those from Socotra are darker but not as dark as the darkest specimens in the British Museum (from Ceylon). The presence of more or less extensive pale scaling on the posterior aspect of the costa appears to be a general feature of Arabian material from all these sources. Specimens from the Eastern Aden Protectorate agree more or less with the Red Sea form in their terminalia, but there is some variation and the differences noted by Edwards between this form and the Madagascar form are, in any event, slighter than his figure would suggest. They appear to amount to little more than variation in the minor spiculation of the lateral plate of the phallosome and to be related to the general degree of darkening and sclerotization of the individual specimen. Larvae from Socotra published by Leeson and Theodor (1948 : 228) as *C. thalassius* are in fact *C. sitiens*. The mistake appears to have arisen from the unjustified use by Hopkins (1952 : 248) of the number of comb scales as a key character.

Culex tritaeniorhynchus. As noted above (p. 93), this species was published from Socotra (by Leeson and Theodor, 1948 : 228) as *C. thalassius*. It was reidentified by one of us (P. F. M.) from male and female adults, male terminalia and a whole larva.

Culex univittatus. Yemen specimens (one male and one female in the British Museum) were formerly assigned by one of us (P. F. M., in Knight 1953*b* : 232) to var. *neavei* Theobald. They are, however, in very poor condition and as the rest of our Arabian material comprises only a few whole larvae we prefer to leave the question of the identity of the Arabian forms open to question. The Yemen male is, however, quite certainly not var. *perexiguus* Theobald, to which the Oman form may be presumed, on distributional grounds, to belong. Var. *perexiguus* is recognizable only on the male terminalia (see Mattingly, 1954 : 56). This form is also likely to be found in north-western Arabia since it is the form occurring in Egypt and Transjordan.

KEYS TO FEMALE ADULTS

The following keys have been carefully checked with the available material and should enable a correct identification to be made in the majority of cases. Where doubt arises reference must be made either to the egg (of *Anopheles*), the female pharynx (of *Anopheles* and *Culex*) or the male terminalia. It is hoped to publish keys to these in a later paper. For the present the reader is referred to the general literature.

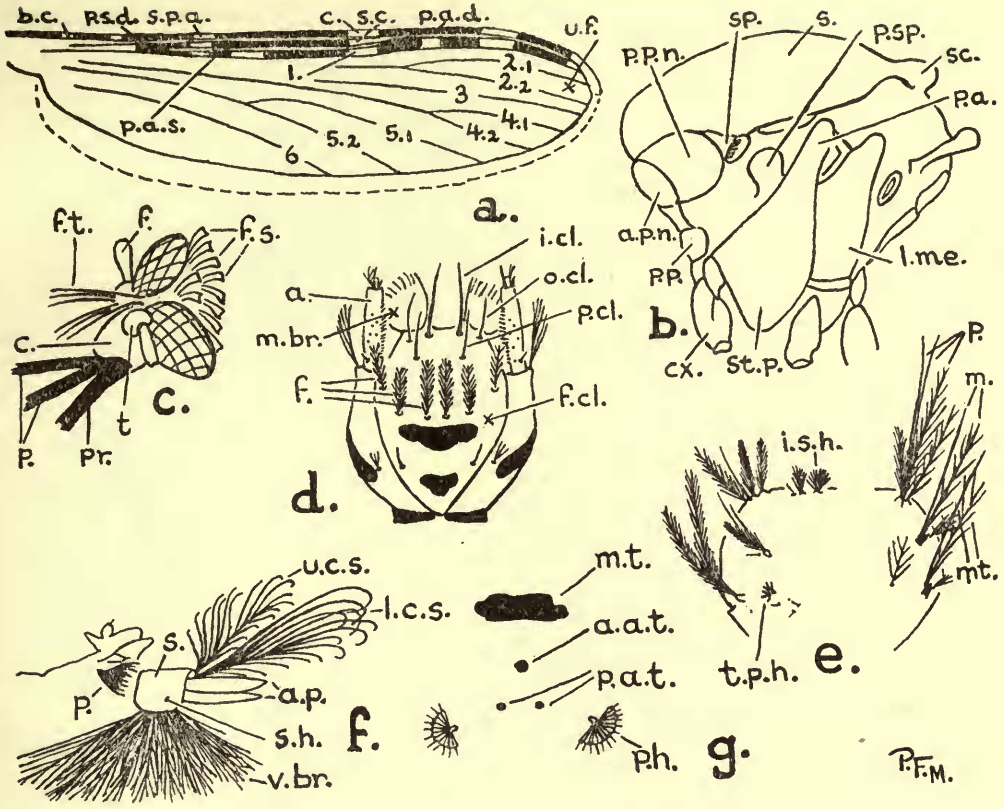

FIG. 2.—Characters employed in the keys.

a. Generalized anopheline wing. *b.c.*, Basal costal interruption ; *c.*, costal vein ; *p.a.d.*, preapical dark spot ; *p.a.s.*, pre-accessory sector spot ; *p.s.d.*, presector dark spot ; *s.c.*, subcostal vein ; *s.p.a.*, sector pale area ; *u.f.*, upper fork cell ; 1–6, First to sixth veins.

b. Generalized thorax in lateral view, showing principal seta- and scale-bearing areas. *a.p.n.*, anterior pronotal ; *cx.*, coxal; *l.me.*, lower mesepimeral ; *p.a.*, prealar ; *p.p.*, propleural ; *p.p.n.*, posterior pronotal ; *p.sp.*, postspiracular ; *s.*, scutal (mesonotal) ; *sc.*, scutellar ; *sp.*, spiracular ; *st.p.*, sternopleural.

c. Anopheline head (diagrammatic). *c.*, Clypeus, *f.*, first segment of antennal flagellum ; *f.s.*, upright forked scales of vertex ; *f.t.*, frontal tuft ; *p.*, bases of palps ; *pr.*, base of proboscis ; *t.*, torus.

d. Head of *Anopheles sergenti* (pale form). *a.*, Antenna ; *f.*, frontal hairs ; *f.cl.*, fronto-clypeus ; *i.cl.*, inner clypeal hair ; *m.br.*, mouth brush ; *o.cl.*, outer clypeal hair ; *p.cl.*, posterior clypeal hair.

e. Generalized thorax of anopheline larva (dorsal on the left, ventral on the right). *i.s.h.*, Inner shoulder hair ; *t.p.h.*, thoracic palmate hair ; *p.*, long propleural bristles ; *m.*, long mesopleural bristles ; *mt.*, long metapleural bristles.

f. Terminal segments of larva of *Anopheles hyrcanus*. *a.p.*, Anal papillae ; *l.c.s.*, lower caudal seta ; *p.*, pecten ; *s.*, saddle ; *s.h.*, saddle hair ; *u.c.s.*, upper caudal seta ; *v.br.*, ventral brush.

g. Fifth abdominal segment of larva of *Anopheles culicifacies adenensis*. *a.a.t.*, Anterior accessory tergal plate ; *m.t.*, main tergal plate ; *p.a.t.*, posterior accessory tergal plates ; *p.h.*, palmate hair.

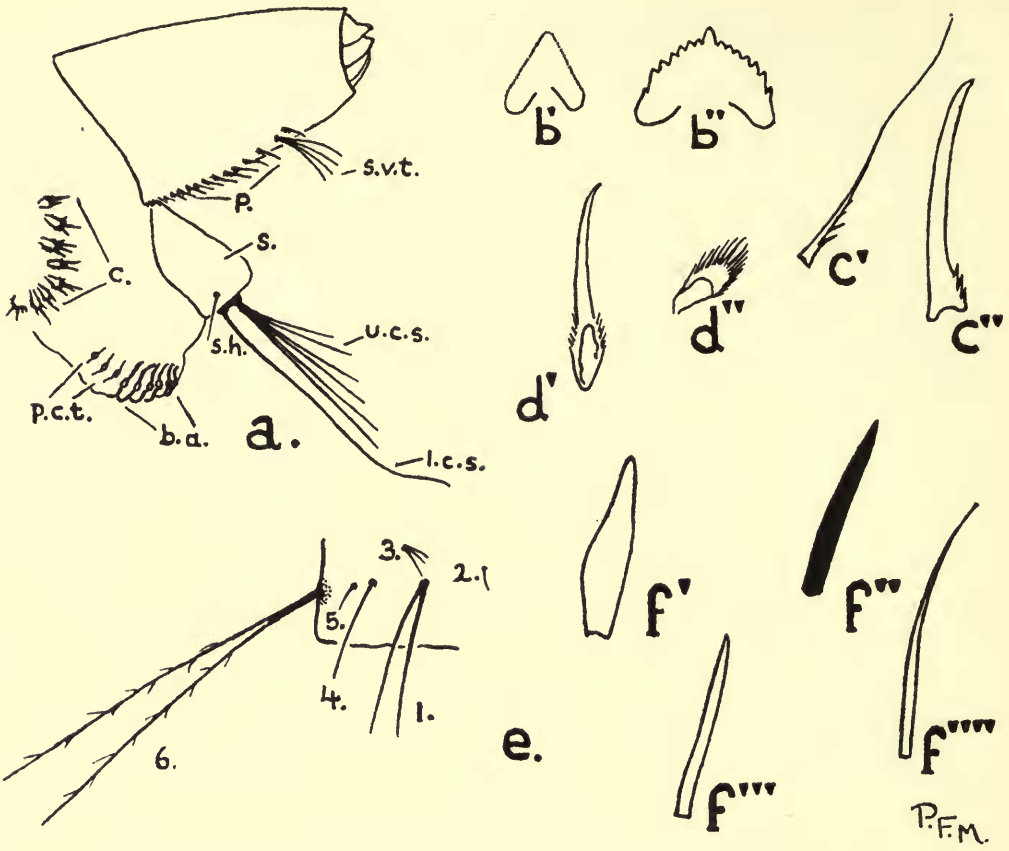

FIG. 3.—Characters employed in the keys (continued).

a. Terminal segments of larva of *Aëdes vittatus* from Awabil showing atypical comb spines. *b.a.*, Barred area of ventral brush ; *c.*, comb ; *l.c.s.*, lower caudal seta ; *p.*, pecten, *p.c.t.*, bases of precratal tufts ; *s.*, saddle ; *s.h.*, saddle hair ; *s.v.t.*, subventral tuft of siphon ; *u.c.s.*, upper caudal seta.

b. Mentum. *b'.*, *Culex ethiopicus* ; *b".*, *Culex theileri*.

c. Terminal pecten teeth. c'., *Aëdes natronius* ; c"., *Culex theileri*.

d. Comb teeth. *d'.*, *Aëdes caballus* ; *d".*, *Aëdes caspius*.

e. Third abdominal segment of larva of *Culex pipiens* (dorsal view). 1., Subdorsal seta ; 6., lateral seta.

f. Pre-clypeal spines. *f'.*, *Culex sitiens* ; *f".*, *Culex tritaeniorhynchus* ; *f"'.*, *Culex laticinctus* ; *f"".*, *Culex pipiens*.

Key to Genera

1. Female palps of the same order of length as the proboscis ; posterior edge of scutellum without conspicuous lobes . . . . . *Anopheles*.
   Female palps at most about one-third the length of the Proboscis, usually less ; scutellum trilobed . . . . . 2.
2. Spiracular bristles present ; scutum with a conspicuous white lyre-shaped marking ; costa entirely white along anterior border ; small dark spots present at bases of forks and in neighbourhood of cross-veins . . . . . *Culiseta*.

Spiracular bristles absent; scutum without such marking (except in *Aë. aegypti* and *Aë. granti*); wings otherwise marked . . . . . 3.

3. Postspiracular bristles present; fore tarsal claws of female toothed (except in *Aë. granti*) . . . . . *Aëdes.*

Postspiracular bristles absent; fore tarsal claws of female simple . . . . *Culex.*

Genus *Anopheles*

1. Fore margin of wing with less than 4 spots involving both costa and vein 1 . . 2.

Fore margin of wing with at least 4 such spots 5

2. Palps with short appressed scales; legs all dark . . . *rhodesiensis* ssp. *rupicolus*

Palps with long semi-erect scales giving them a shaggy appearance; legs with pale markings . . . . . 3.

3. Segment 5 of hind tarsus white . . . . . 4.

Segment 5 of hind tarsus dark . . . . . *hyrcanus.*

4. First hind tarsal segment with well-marked pale basal ring . . . . *coustani.*

Base of first hind tarsal segment entirely dark or at most with a few pale scales *coustani* var. *tenebrosus.*

5. Fifth hind tarsal segment white. . . . . 6.

Fifth hind tarsal segment dark or at most very narrowly pale at base . . . 8.

6. Abdominal segments largely or wholly devoid of scales (fourth and fifth hind tarsal segments wholly white) . . . . . *pretoriensis.*

Abdominal segments with numerous scales which form projecting tufts at the distal corners . . . . . 7.

7. Distal part of second hind tarsal segment and the whole of the third to the fifth white; front femora mainly pale with some dark speckling; mid and hind femora with a longitudinal white line terminating in an oval spot; tibiae mainly pale *pulcherrimus.*

Only the fifth hind tarsal segment entirely white, the other segments with broad white apical bands; femora and tibiae with irregular bands and spots . *pharoensis.*

8. Legs speckled or tibiae with an anterior pale line and mid femora with a pale band or double spot on dorsal aspect towards apex . . . . . 9.

Legs not so marked . . . . . 11.

9. Legs speckled . . . . . 10.

Legs with tibiae striped anteriorly and mid femora with subapical pale spots; (propleural bristles present; preapical dark area on vein 1 uninterrupted) *subpictus.*

10. Scales present on all abdominal tergites except the first; propleural bristles absent; preapical dark area on vein 1 uninterrupted . . . . . *stephensi.*

Scales present only on abdominal tergites VII and VIII; 1–2 propleural bristles present; preapical dark area of vein 1 usually with pale interruption. . *gambiae.*

11. Wings with pale spots confined to the costal region or at most with a few additional pale scales in the neighbourhood of the cross-veins; upright forked scales of head narrow, rodlike . . . . . *dthali.*

Wings with pale spots on all or most of the veins; upright forked scales of the usual type . . . . . 12.

12. All or most of the scutum covered with narrow scales, those on the fossae somewhat broader than the rest; base of costa pale scaled . . . . . *multicolor.*

Scutal fossae bare of scales (hairs often present); base of costa dark . . . 13.

13. Palps dark at tip or apical pale band interrupted giving a four-banded appearance . 14.

Palps three-banded, pale at tip* . . . . . 17.

14. Palps dark at tip . . . . . 15.

Palps pale at tip . . . . . 16.

* So far as is known the type form of *An. demeilloni* (which is the form believed to occur in Arabia) has the female palp invariably three-banded. A four-banded form (var. *carteri* De Meillon & Evans) occurs in South Africa, however, and if this were encountered in Arabia it would be liable to confusion with *An. cinereus*. It differs from the latter in having only one propleural bristle.

15. Dark markings of wing field relatively pale and inconspicuous ; hind tarsi dark *turkhudi*.
Wing markings darker and much more conspicuous (the difference is well seen with the naked eye) ; first three hind tarsal segments often with distinct apical pale spots *cinereus* (in part).
16. Four or more propleural bristles present ; a well marked pre-accessory sector spot present on vein 1 ; first three hind tarsal segments often with distinct apical pale spots . . . . . *cinereus* (in part).
Propleural bristles absent ; sector pale area uninterrupted ; hind tarsal segments at most very faintly pale at tips. . . . . *superpictus* (in part).
17. Propleural bristles absent ; subapical segment of palp about two-thirds the length of the preceding segment or more ; (third vein largely pale ; sector pale area uninterrupted ; scutal scales usually exceptionally broad and numerous) *superpictus* (in part).
At least one propleural bristle present ; subapical segment of palp usually not more than about three-fifths the length of the preceding segment, often less. . . 18.
18. That part of vein 1 proximal to the presector dark spot with a well-marked dark area . . . . . 19.
That part of vein 1 proximal to the presector dark spot wholly pale on upper surface of wing . . . . . 20.
19. Filaments of cones of female pharynx with spicular branches . . *culicifacies*.
These filaments smooth . . . . . *culicifacies* ssp. *adenensis*.
20. Wing with third vein largely or wholly dark . . . . . *sergenti*.
Wing with third vein largely pale . . . . . 21.
21. Vein 1 with well-marked pre-accessory sector spot. . . . . *demeilloni*.
Pre-accessory sector spot absent or rudimentary . . . . . *fluviatilis*.

Genus *Aëdes*

1. Scutum with a continuous border of white scales and a narrow median white line extending the whole length and forking in front of the scutellum ; middle tibia with an anterior white line from base to tip ; proboscis with a white line above from base nearly to tip . . . . . *granti*.
Markings otherwise . . . . . 2.
2. Clypeus scaly (though not always in the male) ; middle femur with an anterior white stripe from base almost to tip ; scutum with strongly marked lyre-shaped ornamentation (except in abnormally pale specimens in which the scutum may appear almost wholly whitish) . . . . . *aegypti*.
Clypeus bare (except in *Aë. vittatus*) ; ornamentation quite otherwise . . . 3.
3. Scutum with three pairs of small, round, snow-white spots ; femora each with a preapical white ring. . . . . *vittatus*.
Otherwise marked . . . . . 4.
4. Hind tarsi with pale rings embracing the joints ; fifth hind tarsal segment pale *caspius*.
Hind tarsi with pale rings confined to bases of segments ; fifth hind tarsal wholly or largely dark . . . . . 5.
5. Several lower mesepimeral bristles present ; abdominal tergites II–VI largely creamy, each with a pair of dark spots . . . . . *caballus*.
At most one lower mesepimeral bristle present, usually none ; tergites otherwise marked . . . . . 6.
6. Wing scales all dark (except sometimes at base of costa and first vein) ; tibiae dark or inconspicuously speckled . . . . . *arabiensis*.
Wings with at least some scattered pale scales ; tibiae heavily speckled . . 7.
7. Wing with relatively few pale scales which are mainly confined to the basal half *hirsutus* var. *adenensis*.
Whole wing with numerous scattered pale scales . . . . . *natronius*.

Genus *Culex*

1. At least four lower mesepimeral bristles present; femora and tibiae each with an anterior row of well marked pale spots; tarsi dark; proboscis unringed (although some pale scales may be present in middle beneath) . . . . . *tigripes.*
   At most three lower mesepimeral bristles present (except sometimes in *C. duttoni*); markings otherwise . . . . . 2.
2. No lower mesepimeral bristle present; proboscis usually with a well developed pale ring in middle; tarsi with distinct pale rings at the joints . . . . . 3.
   1–3 lower mesepimeral bristles present; proboscis usually without a complete pale ring; tarsi dark (except in *C. duttoni*) . . . . . 5.
3. Wings with numerous scattered pale scales; abdominal tergites with apical pale bands of even width . . . . . *ethiopicus.*
   Wings with few or no pale scales (except sometimes on posterior margin of costa); abdominal tergites with pale bands basal . . . . . 4.
4. Fore and mid femora with numerous scattered pale scales on the anterior surface; upper fork cell of wing short, its base distal to that of the lower fork . *sitiens.*
   Fore and mid femora with few or no scattered pale scales; upper fork cell usually longer, its base at least slightly proximal to that of the lower fork cell . . *tritaeniorhynchus.*
5. Tarsi, especially of hind legs, with narrow pale rings; (usually with more than one lower mesepimeral bristle; middle tibia with white anterior stripe; hind tibia dark) *duttoni.*
   Tarsi dark . . . . . 6.
6. Abdominal tergites without complete basal pale bands (basi-lateral pale patches or apical pale bands or patches may be present) . . . . . 7.
   Abdominal tergites with complete basal pale bands . . . . . 11.
7. Abdominal tergites without apical pale markings. . . . . 8.
   Abdominal tergites with apical pale markings . . . . . 10.
8. Vertex with a band of broad whitish scales adjoining the eyes; integument of scutum and pleurae with a frosty grey appearance . . . . . *nebulosus.*
   All decumbent scales of vertex narrow; integument of scutum and pleurae brown . 9.
9. First hind tarsal segment approximately equal in length to the tibia; prealar scales present . . . . . *univittatus* var. *neavei.*
   This segment much shorter than the tibia; prealar scales absent . . *pusillus.*
10. Abdominal tergites with the apical pale bands broad and complete; postspiracular scales present . . . . . *arbieeni.*
    Abdominal tergites with apical pale bands narrow or incomplete (sometimes reduced to small apicolateral patches); postspiracular scales absent . . *salisburiensis.*
11. Postspiracular and prealar scales present . . . . . 12.
    Postspiracular scales always and prealar scales usually absent . . . . 15.
12. Hind tibia (and sometimes also the fore and mid femora and tibiae) with pale anterior stripe . . . . . 13.
    Femora and tibiae without pale anterior stripes (except sometimes on the mid leg in *C. simpsoni*) . . . . . 14.
13. Hind femur with anteroventral dark stripe on about the distal half; upper and lower scale patches on sternopleura confluent; basal bands on abdominal tergites produced posteriorly in the mid-line, at least on anterior segments . . *theileri.*
    Hind femur with only about the distal one-eighth of the anteroventral surface dark; upper and lower scale patches on sternopleura separate; abdominal tergites with basal pale bands or spots without posterior prolongation in the mid-line . . *univittatus.*
14. Sternites usually with dark apical bands; front coxae with some dark scales; (male palps normal) . . . . . *simpsoni.*

Sternites often without dark apical bands ; scales of front coxae sometimes all pale ; (male palps shorter than usual and nearly bare) . . . . . *sinaiticus.*

15. Sternites with dark apical bands ; (scutal scales with pronounced reddish tint ; proboscis dark beneath) . . . . . *decens.*

Sternites without dark apical bands . . . . . 16.

16. Two to four lower mesepimeral bristles normally present ; proboscis dark beneath . *laticinctus.*

Only one lower mesepimeral bristle normally present ; proboscis partly pale beneath 17.

17. Wing length about 6 mm.; (only a few hairs present on apical segments of male palps) . . . . . *mattinglyi.*

Wing length about 4 mm.; (male palps hairy as usual). . . . . 18.

18. Scutal scales reddish brown ; (upper fork cell, in female, more than three times as long as its stem ; male palps exceeding the proboscis by the length of the apical segment and about half the length of the subapical) . . . . . *pipiens.*

Scutal scales more buff tinted or scutal integument paler ; (male palps exceeding the proboscis by at most the length of the apical segment) . . . . . 19.

19. Upper fork cell of wing at least three times the length of its stem *pipiens* var. *molestus.*

Upper fork cell at most about two and a half times the length of its stem *pipiens* ssp. *fatigans.*

KEYS TO FOURTH STAGE LARVAE

Key to Genera

1. Siphon absent . . . . . *Anopheles.*

Siphon present . . . . . 2.

2. Siphon with numerous subventral tufts . . . . . *Culex.*

Siphon with only one subventral tuft . . . . . 3.

3. Subventral tuft of siphon arising near base . . . . . *Culiseta.*

Subventral tuft arising at about half way between base and apex of siphon or beyond . . . . . *Aëdes*

Genus *Anopheles*

1. Inner clypeal hairs with bases nearly touching . . . . . 2.

Inner clypeal hairs with bases widely separated . . . . . 3.

2. Pecten with 9–14 long teeth, usually at least 10 ; inner shoulder hair (hair 1 of prothorax) often branched from near base . . *coustani*, *coustani* var. *tenebrosus.*

Pecten with 6–9 long teeth ; inner shoulder hair usually simple or branched at tip only . . . . . *hyrcanus.*

3. Outer clypeal hairs branched . . . . . 4.

Outer clypeal hairs simple or at most frayed or split at tip . . . . . 5.

4. Outer clypeal hairs with 4–12 branches ; inner clypeal hairs distinctly frayed with several delicate branches on the distal two-thirds ; one long mesopleural bristle simple . . . . . *pulcherrimus.*

Outer clypeal hairs with about 20–45 branches ; inner clypeal hairs lightly feathered beyond middle ; both long mesopleurals simple . . . . . *pharoensis.*

5. Main tergal plates on abdominal segments III–VII very large, their posterior borders enclosing the anterior accessory tergal plate ; width of main plate on segment V at least three-quarters of the distance between the palmate hairs ; (metathoracic palmate hair exceptionally well developed) . . . . *fluviatilis.*

Anterior accessory tergal plates always entirely free ; width of main tergal plate on segment V not more than two-thirds of the distance between the palmate hairs (except sometimes in *An. sergenti* and *An. culicifacies adenensis*) . . . . 6.

6. Both long mesopleural bristles feathered ; mouthbrushes projecting at right angles to the long axis of the fronto-clypeus . . . . . 7.

At least one mesopleural bristle simple (except as an occasional aberration in *An. multicolor*) ; mouthbrushes, when fully expanded, projecting obliquely . . 8.

7. Leaflets of abdominal palmate hairs with well marked shoulders on segments III–VII ; filaments of leaflets sharply pointed and about half length of blades . . *cinereus*.
Well developed palmate hairs on segments IV–VII only ; filaments of leaflets extremely short and blunt . . . . . *turkhudi*.

8. Both long metathoracic pleural hairs feathered . . . . . 9.
One long metathoracic pleural hair simple . . . . . 13.

9. Both long mesothoracic pleural bristles usually simple (the dorsal one sometimes split at about its middle into 2–4 branches) ; (bases of frontal hairs not surrounded by discrete dark spots ; inner anterior clypeal hairs devoid of fraying). . *subpictus*.
One long mesopleural bristle feathered . . . . . 10.

10. Seta 1 of metathorax differentiated to form a palmate hair ; inner anterior clypeal hairs with delicate fraying ; (no pigmentation round bases of frontal hairs) *superpictus*.
Seta 1 of metathorax undifferentiated ; inner anterior clypeal hairs without fraying (except sometimes in *An. stephensi*. A single barbule sometimes present in *An. pretoriensis*) . . . . . 11.

11. Inner shoulder hair (prothoracic hair 1) with basal tubercle absent or very poorly developed ; (well marked dark spots round bases of frontal hairs which may be fused to form a continuous band) . . . . . *multicolor*.
Inner shoulder hair with well developed chitinized tubercle . . . . . 12.

12. Palmate hair of segment II of abdomen small but with shoulders of leaflets well developed ; basal tubercles of inner and middle shoulder hairs (prothoracic hairs 1 and 2) often fused ; metathorax sometimes with a pair of small submedian tergal plates ; inner anterior clypeal hairs simple or at most with a single small barbule *pretoriensis*.
Palmate hair of segment II poorly developed ; basal tubercles of shoulder hairs separate ; metathorax without tergal plates ; inner anterior clypeal hairs often frayed . . . . . *stephensi*.

13. Both long mesopleural bristles simple (one occasionally feathered on one side of the thorax as an aberration in *An. dthali*) . . . . . 14.
One long mesopleural bristle feathered . . . . . 17.

14. Inner shoulder hair (prothoracic hair 1) without chitinized basal tubercle ; posterior accessory tergal plates absent ; inner anterior clypeal hairs often frayed . *gambiae*.
Inner shoulder hairs with chitinized basal tubercles ; paired posterior accessory tergal plates present on posterior abdominal segments ; inner anterior clypeal hairs always simple . . . . . 15.

15. Both pairs of caudal hairs with branches strongly hooked ; posterior clypeal hairs approximately equal in length to the outer anterior clypeals . . . *dthali*.
Branches of inner (upper) caudal hairs straight, their ends not recurved ; posterior clypeal hairs distinctly shorter than the outer clypeals . . . . . 16.

16. Fronto-clypeus with a characteristic dark Y-shaped marking, the paired arms of which extend forward well beyond the frontal hairs *culicifacies* ssp. *adenensis* (in part).
Clypeus otherwise marked . . . . . *culicifacies*.

17. Inner (upper) caudal hairs with branches straight, their ends not recurved ; paired posterior accessory tergal plates always present on posterior abdominal segments *culicifacies*. ssp. *adenensis* (atypical).
Inner caudal hairs with at least some branches hooked ; paired posterior accessory tergal plates absent (except in *An. dthali* and sometimes in *An. sergenti*) . . 18.

18. Paired posterior accessory tergal plates present on posterior abdominal segments *sergenti* (in part).
These plates entirely absent . . . . . 19.

19. Integument of fronto-clypeus frequently with a well marked dark band immediately posterior to the frontal hairs; base of antenna with spicules subequal; inner anterior clypeal hairs simple . . . . . 20.
Integument of fronto-clypeus often appearing almost unicolorous, at most with faintly marked spots which do not form a continuous band behind the frontal hairs; base of antenna with some spicules conspicuously longer than the others and these tending to form a distinct group; inner anterior clypeal hairs often lightly frayed *rhodesiensis* ssp. *rupicolus*.

20. Tubercle at base of inner shoulder hair (hair 1 of prothorax) variable in size, usually small, sometimes absent; width of main tergal plate on segment V of abdomen at least two-thirds of the distance between the palmate hairs, often more *sergenti* (in part).
Tubercle at base of inner shoulder hair large and strongly chitinized; main tergal plates smaller, the width of that on segment V not more than five-eighths of the distance between the palmate hairs . . . . . *demeilloni*.

Genus *Aëdes*

1. Antenna smooth; antennal seta minute, single; ventral brush without precratal tufts proximal to the main barred area . . . . . 2.
Antenna usually spiculate (the spicules often few and small, and perhaps sometimes absent altogether, in *Aë. vittatus* and *Aë. natronius*); antennal seta usually branched (sometimes single in *Aë. vittatus*); ventral brush with two or more tufts proximal to the barred area . . . . . 3.

2. Submedian denticles of typical comb spines strongly developed giving these spines a trifid appearance under low powers of the microscope . . . . *aegypti*.
Submedian denticles of typical comb spines very small, only an occasional aberrant spine appearing trifid . . . . . *granti*.

3. Head hairs 5 and 6 (inner and mid frontal hairs, hairs C and B, respectively, of Hopkins, 1952) single or double, about equal in length . . . . . 4.
Either one at least of these hairs (usually both) with three or more branches or hair 6 much longer (and usually stouter) than 5 . . . . . 7.

4. Comb of 25–30 spines with median denticles not, or only slightly, more conspicuous than the lateral ones . . . . . *caspius*.
Comb of at most 12 spines, typical spines with stout median denticle and basal fringe (the median denticle sometimes reduplicated and the submedian denticles sometimes hypertrophied in aberrant spines) . . . . . 5.

5. Pecten with none of the spines more widely spaced than the others . . . *caballus*.
Pecten with at least one of the distal spines more widely spaced . . . . 6.

6. Antenna very sparsely spiculate (if at all); head seta 5 simple; pecten with only one tooth more widely spaced and this lying beyond the subventral siphonal tuft *vittatus*.
Antenna more strongly spiculate; head seta 5 plumose; pecten with 1–3 of the distal teeth more widely spaced and these all lying proximal to the subventral tuft *arabiensis*.

7. Antenna very sparsely spiculate (if at all); pecten teeth drawn out at their tips into long, slender, transparent filaments; head seta 6 with at least two branches, often more, not or only slightly longer than 5 . . . . . *natronius*.
Antenna more strongly spiculate; pecten teeth of more normal type; head seta 6 normally single, rarely double, much longer and usually stouter than 5 *hirsutus* var. *adenensis*.

Genus *Culex*

1. Setae of mouth-brushes modified to form strong curved spines; pecten teeth extending to apex of siphon . . . . . *tigripes*.
Setae of mouth-brushes unmodified; pecten not extending to apex of siphon . 2.

2. Siphon with about 20 subdorsal setae on distal two-thirds; (thorax and abdomen strongly spiculate) . . . . . *arbieeni*.
Siphon with at most about 8 subdorsal setae, usually less . . . . . 3.
3. Siphon very strongly swollen, biconvex, with long single subventral setae and a more or less well marked dark band near the apex . . . . . *duttoni*.
Siphon otherwise . . . . . 4.
4. Comb composed wholly or partly of spines . . . . . 5.
Comb composed entirely of scales (though these may look like spines in lateral view) 8.
5. Mentum a straight-sided triangle edged with numerous very minute teeth; comb with at most nine teeth; pecten confined to extreme base of siphon . . *ethiopicus*.
Mentum less regular in shape with large teeth; comb with at least about fourteen teeth; pecten more extensive . . . . . 6.
6. Comb composed of spines only; more distal pecten teeth very large and strongly curved . . . . . *theileri*.
Comb usually composed partly of scales; distal pecten teeth not strongly modified. 7.
7. Pecten extending for one-third the length of the siphon or less . . . *simpsoni*.
Pecten longer than this . . . . . *sinaiticus*.
8. Head setae 5 and 6 single; siphon strongly flared at tip . . . *salisburiensis*.
Head setae 5 and 6 with at least two branches; siphon not or only very slightly flared at tip . . . . . 9.
9. Head and siphon blackish; antenna less than half length of head; siphonal index 3 or less; anal papillae about three times the length of the saddle . . *nebulosus*.
Head and siphon at most dark brown; antenna at least half the length of the head; siphonal index usually greater; anal papillae usually shorter than this . . 10.
10. Pre-clypeal spines short, dark and extremely thick; anal papillae very small and rounded, about half the length of the saddle or less; (siphonal index not more than 6, usually less) . . . . . *sitiens*.
Without this combination of characters . . . . . 11.
11. Siphonal index 6 or more . . . . . 12.
Siphonal index less than 6 . . . . . 16.
12. Pre-clypeal spines long, hairlike; siphonal index at most 6·5 . . *pipiens* (in part).
Pre-clypeal spines shorter, spinelike or siphonal index more than 7·5, usually both . 13.
13. Pre-clypeal spines stout, blackish; subventral tufts of siphon at least slightly longer than the diameter of the siphon at point of attachment . . . *tritaeniorhynchus*.
Pre-clypeal spines more slender, usually paler; subventral tufts at most equal in length to the diameter of the siphon at point of attachment . . . . 14.
14. Denticles of more distal pecten teeth numerous, very regular in size and arising along the whole ventral side of the tooth . . . . . sp. indet.
Denticles of more distal pecten teeth less numerous (at most 5), irregular in size and position and not arising along the whole length of the tooth . . . . 15.
15. Siphonal index 8–11; ventral pair of anal papillae markedly shorter than the dorsal pair; lateral hair of abdominal segments III and V very long and single . *decens*.
Siphonal index 6–7·5; ventral pair of anal papillae not much shorter than the dorsal pair; lateral hair of segments III and V with at least two branches . . *univittatus*.
16. Inner (upper) caudal seta with at least four branches; ventral brush with 13–15 tufts (usually 14); mentum with 7–8 teeth on either side of the main central tooth; preclypeal spines spinelike . . . . . *laticinctus*.
Inner caudal seta with at most three branches; ventral brush with 12–13 tufts (usually 12); mentum with 7–13 lateral teeth; preclypeal spines hairlike . . 17.
17. Subventral tufts arising very close to the mid line, the most distal very near the apex; antenna strongly pigmented at base and beyond antennal tuft, pale in between; mentum with 7–8 teeth on either side of the central tooth. . . . *pusillus*.

Subventral tufts more lateral in position ; antenna more or less unicolorous or contrast between light and dark areas relatively slight ; mentum with lateral teeth usually more numerous . . . . . 18.

18. Siphon with 11–16 subventral tufts ; pecten with 14–19 teeth ; thoracic integument distinctly spiculated ; several of the subventral siphonal tufts inserted basad of the distal end of the pecten . . . . . *mattinglyi*.

Siphon with 6–10 subventral tufts ; pecten with 8–19 teeth ; thoracic integument without distinct spiculation ; at most one pair of subventral tufts inserted basad of the distal pecten tooth . . . . . 19.

19. Siphonal index usually more than 5 ; (subdorsal seta (hair 1) of abdominal segment III(and to a less extent IV) usually double*) . . . . . *pipiens* (in part).

Siphonal index never more than 4·8, usually less . . . . . 20.

20. Hair 1 of abdominal segments III and IV usually double* . . *pipiens* var. *molestus*.

This hair usually single* . . . . . *pipiens* ssp. *fatigans*.

DISTRIBUTION RECORDS

In many cases the following records were published without citing the date of collection. Wherever possible the dates in question have been ascertained from the data labels of preserved specimens and are here included. The boundaries of the various political divisions of the Arabian peninsula are shown in Text-fig. 2 The abbreviations B.M., L.S.H. and U.S.N.M. refer to the British Museum, the London School of Hygiene and the United States National Museum respectively.

Anopheles coustani s. str. W. Saudi Arabia. Jadaliya, 25.xi.1936, H. St.J. B. Philby (B.M.).

Anopheles coustani var. *tenebrosus*. E. Saudi Arabia. Katif and El-Khobar area, C. M. Hopkins (as *An. coustani* s.l., Leeson, 1948 : 254), near Hoffuf 4.ii.1944, C. M Hopkins (as *An. hyrcanus*, Leeson, 1948 : 254), Ain Rohem, 14.iii.1944, C. M. Hopkins (L.S.H.), El-Ajam, R. H. Daggy (Leeson, 1948 : 254), Ras Tanura, 29.iii. 1948, El-Ajam, 7.i–25.ii.1948, R. H. Daggy (U.S.N.M.). Oman. Jurbaib, 29.x. 1930, B. S. Thomas (as *An. mauritianus* de Gr. & de Ch., Edwards *in* Thomas, 1931 : 235, as *An. coustani* var. *tenebrosus*, Evans, 1938 : 73).

Anopheles cinereus. Yemen. El-Amra, 9.i.1951, El-Hauban (Wadi el-Malah), 6.i.1951, Birket Ghail Masnah, 5.ii.1951, Wadi Mal el-Ghail, 7.ii.1951, San'a, 12.ii.1951, K. L. Knight (Knight, 1953*b* : 219), San'a, viii.1945, L. Merucci (L.S.H.). W. Aden Prot. Hardeba, xii.1904, i.1905, Sulek, i.1905, Jebel Jehaf, D'thala, W. S. Patton (as *An. jehafi* sp. n., Patton, 1905 : 632, as *An. cinereus*, Edwards, 1912 : 249), Mikhuras, x.1954 (B.M.). W. Saudi Arabia. Abah, 19 and 22.1944, A. R. Waterston (B.M.).

Anopheles culicifacies. Bahrein. Manama, Arad (Afridi & Majid, 1938 : 469). Trucial Oman. Most parts, C. M. Hopkins (Leeson, 1948 : 254), Dmeith, 29.iii.1944 El-Kelba, 30.iii.1944, C. M. Hopkins (L.S.H.). Oman. Wadi Bait al-Falaj, xi.1914–iii.1915 and x–xii.1915, Muscat, Darsait, Sidab, x–xii.1915, C. A. Gill (Gill, 1916 : 208).

Anopheles culicifacies ssp. *adenensis*. Yemen. Hodeida, ii, iv and v.1944 and vi.1945, L. Merucci (as *An. culicifacies* var. *adenensis*, Buxton, 1944 : 211, Merucci,

* This is a statistical character involving the examination of at least 10 specimens of any one form. Hybrids are intermediate. (See Knight (1953*c*), who, however, erroneously described the subdorsal seta as hair 4).

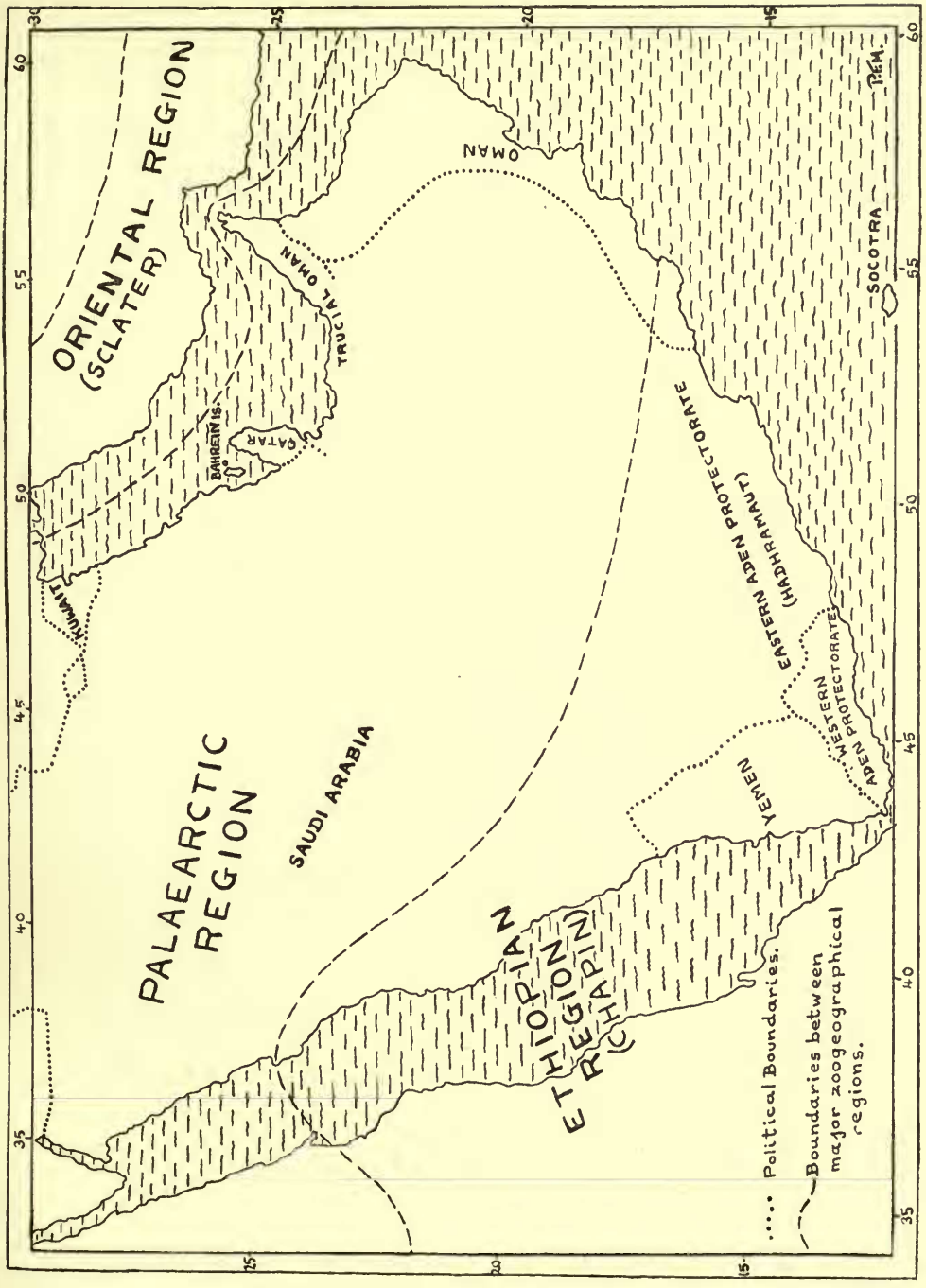

FIG. 4.—Political divisions of the Arabian peninsula. The boundary between the Ethiopian and palaearctic regions is taken from Chapin (1932 : 90).

1954 : 211, as *An. adenensis*, De Meillon, 1947 : 100), 28, 29 and 31.i.1951, K. L. Knight (as *An. adenensis*, Knight, 1953*b* : 219). W. ADEN PROT. Aden (as *An. culicifacies*, Phipson, 1934 : 46), Hinterland, K. Chand (as *An. culicifacies*, Christophers & Chand, 1915 : 186), Sheikh Othman, Dar al-'Amir, Al-Anad, Lahej (as *An. culicifacies* var. *adenensis*, Christophers, 1924 : 296). SOCOTRA. Hadibo, 7–8.xii. 1942, 11.i.1943, Kathub, Wadi Tintern, Nee, G. F. W. Hart (as *An. culicifacies* var. *adenensis*, Leeson & Theodor, 1948 : 225), Hadibo, ii.1954, N. L. Corkill (B.M.), Khor Hadjun, 12.xii.1942, G. F. W. Hart (L.S.H.), Unnamed localities, G. F. W. Hart (De Meillon, 1947 : 101). TRUCIAL OMAN. El-Kelba, 30.iii.1944, C. M. Hopkins (Leeson, 1948 : 254).

Anopheles demeilloni. YEMEN. Wadi Grab (near Ma'bar), 6.ii.1951, K. L. Knight (as *An. fluviatilis*, Knight, 1953*b* : 220). W. ADEN PROT. Mikhuras, x.1954 (B.M.).

Anopheles dthali. YEMEN. Wadi Raidan, 25.i.1951, Wadi Siham (near 'Obal, 4.ii.1951, K. L. Knight (Knight, 1953*b* : 220), Wadi So'lu (near Ta'izz), vi.1945, Wadi Rishan, (near Ta'izz), xii.1946, C. Toffolon (Buxton, 1944 : 211). W. ADEN PROT. Hardeba, x.1904–iv.1905, Sulek, i.1905, D'thala, Nobat Dakim, W. S. Patton (Patton, 1905 : 627), Wadi Tiban (as *An. rhodesiensis*, Christophers & Chand, 1915 : 182, as *An. dthali*, Christophers & Puri, 1931*b* : 1134). Wadi Ma'adin, 2 and 11.ii.1940, Huweimi, Qoreina and Kirsh (Wadi Natd), Tor um Baha, P. W. R. Petrie (Petrie & Seal, 1943 : 42–81). W. SAUDI ARABIA. Jedda, 22.i.1946, N. L. Corkill (B.M.). E. ADEN PROT. Mukalla, ii and iii.1952, Jizwal, 27.iv.1953, Meifa 28.iv.1953, Mehmida, 26.iv.1953, Sidara, 22.iv.1953, Harshiyat, iii.1953, 27.iv. 1953, Khirba, iii.1953, Wasita, Geregeri, 25.v.1953, Urfat Subai, Sukhal al-Dis, 24.v.1953, N. L. Corkill (B.M.). SOCOTRA. Everywhere (as *An. dthali* var. *wardi* var. nov., Leeson & Theodor, 1948 : 222), Hadibo, 8.xii.1942, Kallansiya, 5.i.1943, Kathub, 5–6.xii.1942, Khor Hadjun, 7.xii.1942, Wadi Killiem, 17.i.1943, G. F. W. Hart (B.M.), Kathub, 28.xii.1942, Kallansiya, 6.i.1943, Hayoo, 7.i.1943, Devil's Creek, 7.xii.1942, A'aith, 14.i.1943, Mouri, 21.xii.1942, Beyond Goor, 15.i.1953, G. F. W. Hart (L.S.H.), Hadibo, ii.1954, N. L. Corkill (B.M.). OMAN. Wadi Bait al-Falaj, iii–vi.1915 and x–xii.1915, C. A. Gill (as *An. rhodesiensis*, Gill, 1916 : 209).

Anopheles fluviatilis. E. SAUDI ARABIA. Near Katif, El-Khobar, i.1944, Hoffuf, C. M. Hopkins (Leeson, 1948 : 254), Saihat, i.1947–ii.1948, R. H. Daggy (Leeson, 1948 : 254), Hoffuf, 6.ii.1944, Safwa, 14.iii.1944, C. M. Hopkins (L.S.H.), Saihat, 10.xi.1947, R. H. Daggy (U.S.N.M.). BAHREIN. Manama (Afridi & Majid, 1938 : 469). OMAN. Wadi Bait al-Falaj, xi.1914–vii.1915 and x–xii.1915 (as *An. funestus* var. *arabica*, Gill, 1916 : 209, Christophers & Chand, 1915 : 189, as *An. arabicus*, Christophers & Puri, 1931*a* : 486).

Anopheles gambiae. YEMEN. El-Amra, 9.i.1951, Ta'izz, 12.i.1951, Wadi Raidan, 25.i.1951, K. L. Knight (Knight, 1953*b* : 220), Ta'izz, C. Toffolon, 1943–1945 (Buxton, 1944 : 212, Merucci, 1954 : 211), Madinat el-Abid, 1946, Wadi Worazan 1945, C. Toffolon, ((Merucci, 1954 : 211). W. ADEN PROT. Aden (as *An. subpictus*, Phipson, 1934 : 46), Wadi Tiban, K. Chand (as *An. costalis* Theobald, Christophers & Chand, 1915 : 192), Sheik Othman, ii.1904, i.1905, Bir Said Ali, ii.1905, Nobat Dakim, iii–xi.1904, Ulub, v.1904, Hardeba, iii.xi.1904, D'thala, v–x.1904, Lahej,

Salim, Sulek, Am Riga, W. S. Patton, Steamer Point. Young (as *An. arabiensis* sp. n., Patton, 1905 : 626), Shuqra, 18.xii.1939, Haski, 31.xii.1939 and 4.i.1940, Wadi Ma'adin, 4.ii.1940, Kod, Abyan, Lahej, El-Waht, Huweimi, Qoreina and Kirsh (Wadi Natid), Tor um Baha, Wadi Hidaba, Museimir, P. W. R. Petrie (Petrie & Seal, 1943 : 13–149), Mikhuras, x.1954 (B.M.). W. Saudi Arabia. Jedda, xii.1936–i.1937, F. P. Mackie, Wadi Liya, 22.i.1937, H. St. J. B. Philby (Buxton, 1944 : 212). E. Aden Prot. Al-Hadba, iii.1952, Harshiyat, iii.1953 and 27.iv. 1953, Jizwal, 27.iv.1953, Hauta (Hajr), 24.iv.1953, Jol Bahawa, 18.iv.1953, Meifa, 28.iv.1953, Sidara, 22.iv.1953, Rukub, iii.1953, Al–Ais, iii.1953, Khirba, iii.1953, Amd Town, i.1954, N. L. Corkill (B.M.).

Anopheles multicolor. W. Saudi Arabia. Jedda, 1936, F. P. Mackie (Buxton, 1944 : 212), 22.i.1946, N. L. Corkill (B.M.). E. Saudi Arabia. El-Kharj, 16–22.ii. 1944, Hoffuf, 6.ii and 6.iii.1944, Katif, El-Khobar, Suleimiya, C. M. Hopkins (Leeson, 1948 : 254), El-Kharj, 30.xii.1947, 7.ii.1948, R. H. Daggy (L.S.H.), 28.i.1948, R. H. Daggy (U.S.N.M.). Trucial Oman. Ras el-Kham'ar, 24.iii.1944, El-Kelba, 30.iii.1944, C. M. Hopkins (L.S.H.).

Anopheles pharoensis. Yemen. El-Hauban (Wadi el-Malah), 16 and 19.i.1951, K. L. Knight (Knight, 1953*b* : 221). W. Saudi Arabia, Jebel el-Scharr (Martini & Hlisnikowski, 1942.*

Anopheles pretoriensis. Yemen. Wadi Raidan, 25.i.1951, Wadi Siham (near 'Obal), 4.ii.1951, K. L. Knight (Knight, 1953*b* : 221), Wadi So'lu, vi.1945, C. Toffolon (L.S.H.), Wadi Worazan, 1945, C. Toffolon (Merucci, 1954 : 211). W. Aden Prot. Hinterland as far up as Jehaf (6,800 ft.), W. S. Patton (as *An. tibani* sp. n., Patton, 1905 : 630, as *An. pretoriensis*, Christophers & Chand, 1915 : 195, as ? *An. theobaldi*, Buxton, 1944 : 212), Wadi Ma'adin, 4.ii.1940, P. W. R. Petrie (Buxton, 1944 : 212), Tor um Baha, P. W. R. Petrie (Petrie & Seal, 1943 : 80).

Anopheles pulcherrimus. E. Saudi Arabia. Katif and El-Khobar area, C. M. Hopkins (Leeson, 1948 : 254), Hoffuf, 6.ii.1944, C. M. Hopkins (L.S.H.), El-Ajam, 12.i.1947 and 29.vii.1947, R. H. Daggy (L.S.H.), El-Ajam and Saihat and Dammam, 30.ix.1947–12.i.1948, R. H. Daggy (U.S.N.M.). Bahrein. Manama, 15–21.v. 1938, Rifa a-Ash Sharqi (Afridi & Majid, 1938 : 444, 469).

Anopheles rhodesiensis ssp. *rupicolus*. Yemen. Ta'izz, viii–ix.1943, C. Toffolon (as *An. dthali*, Buxton, 1944 : 211), 12.i.1951, K. L. Knight (Knight, 1953*b* : 223). W. Aden Prot. Huweimi and Kirsh (Wadi Natid), iii.1940, P. W. R. Petrie (as *An. rupicolus*, Petrie & Seal, 1943 : 63, 82, Buxton, 1944 : 213). E. Aden Prot. Quaidun (Wadi Duan), 5.ix.1952, L. Merucci (B.M.).

Anopheles sergenti. Yemen. El-Hauban (Wadi el-Malah), 16 and 17.i.1951, Wadi Siham (near 'Obal), 4.ii.1951, K. L. Knight (Knight, 1953*b* : 223, San'a, 1945, L. Merucci (Merucci, 1954 : 211). W. Aden Prot. Huweimi and Kirsh (Wadi Natid), iii.1940, P. W. R. Petrie (as ? *An. macmahoni* Evans, Petrie & Seal, 1943 : 63, 82, Buxton, 1944 : 213). W. Saudi Arabia. Jedda, x.1948, N. L. Corkill (B.M.),

* We are indebted for this record to Professor E. Martini, Dr. Jacques M. May of the American Geographical Society and Dr. Jusatz of the University of Heidelberg. The original source of the record cannot be traced, and as we have no indication of the altitude concerned we have ignored it in dealing with the altitudinal distribution of *An. pharoensis*.

Tarfaa (Wadi Fatima), xii.1953, Madaneya (near Medina), vi.1953, W.H.O. Team (L.S.H.). E. ADEN PROT. Shibam, xi.1951, E. Hoeck, Tarim, xi.1951, L. Merucci (B.M.). E. SAUDI ARABIA. Katif and El-Khobar area, C. M. Hopkins (Leeson, 1948 : 254), Safwa, 14.iii.1944, Anaiza, 23.iv.1944, C. M. Hopkins (L.S.H.), El-Khobar, iv. 1948, El-Ajam, i.1947, Dammam, x.1947, R. H Daggy (U.S.N.M.). BAHREIN. Manama 14.v–11.vi.1938 (Afridi & Majid, 1938 : 444).

Anopheles stephensi. E. SAUDI ARABIA. Hoffuf, 6.ii.1944, 6.iii.1944, Katif and El-Khobar area, C. M. Hopkins (Leeson, 1948 : 254), Safwa, 14.iii.1944, C. M. Hopkins (L.S.H.), El-Khobar, 17.iv.1948, Dammam, 30.ix.1947, El-Kharj, 30.xii.1947, 7.ii.1948, Saihat, 2.x.1947, R. H. Daggy (Leeson, 1948 : 254), El-Khobar, Dammam, Saihat, El-Kharj and El-Ajam, 3.x.1947–7.ii.1948, R. H. Daggy (U.S.N.M.). BAHREIN. Unnamed locality, i.1906, A. Bennett (as *Nyssorhynchus metaboles* Theobald, Giles, 1906 : 130), Sakhir, Basaitin (Afridi & Majid, 1938 : 439), Manama, 14.v–15.vi.1938. (Afridi & Majid, 1938 : 444), Galali, Diraz, Rifa a-Ash Sharqi, Muharrak, Khamis. (Afridi & Majid, 1938 : 469). TRUCIAL OMAN. El-Kelba, 30.iii.1944, C. M. Hopkins (Leeson, 1948 : 254). OMAN. Darsait, x–xii.1915, Muscat, xi–xii.1915, C. A. Gill (Gill, 1916 : 208).

Anopheles turkhudi. YEMEN. San'a, vi.1942, L. Merucci (Merucci, 1954 : 211), Aina, 5.xii.1936, H. St.J. B. Philby (B.M.) W. ADEN PROT. Azriki, W. S. Patton (as *An. azriki* sp. n., Patton, 1905 : 633, as *An. turkhudi*, Christophers & Chand, 1915 : 190). Hiswa (Buxton, 1944 : 212), Wadi Tiban, i.1951, K. L. Knight (Knight, 1953*b* : 223). W. SAUDI ARABIA. Madruga, 26.x.1936, F. P. Mackie (Buxton, 1944 : 212).

Culiseta longiareolata. YEMEN. Hamman 'Ali, 5.ii.1951, Wadi Dhahr, 11 and 13.1951, Rouda, 15.ii.1951, San'a, 12.ii.1951, K. L. Knight, 22–30.ix.1937, C. Rathjens, 26.viii.1946, A. R. Waterston (Knight, 1953*b* : 224). W. ADEN PROT. Mikhuras, x.1954 (B.M.), Awabil, iv.1954, N. L. Corkill (B.M.). W. SAUDI ARABIA. Buraiman, 22.i.1946, E. S. Brown (B.M.). E. SAUDI ARABIA. El-Kharj, 31.i.1948, R. H. Daggy (U.S.N.M.), 16–22.ii.1944, C. M. Hopkins (L.S.H.). TRUCIAL OMAN. Khars, 23.iii.1944, C. M. Hopkins (L.S.H.).

Aëdes caballus. E. ADEN PROT. Amd Town, i.1954, Sana (Wadi Rakhya), iv.1954, N. L. Corkill (B.M.).

Aëdes caspius. SOCOTRA. Ras Shoab, i.1899, O. Simony (as *Culex arabicus* sp. n., Becker, 1931 : 140). E. SAUDI ARABIA. El-Kharj, 31.i–4.ii.1948, Saihat, 28.ix.1947, Dammam, 9.ii.1948, R. H. Daggy (U.S.N.M.), Hoffuf, iii.1944, C. M. Hopkins (as *Aë. mariae* Sergent, Hopkins, MS.). BAHREIN. Unnamed locality, i.1906, A. Bennett (as *Mansonia arabica* sp. n., Giles, 1906 : 130).

Aëdes aegypti. YEMEN. Murawah, 30.i.1951, Hodeida, 1.ii.1951, K. L. Knight (Knight, 1953*b* : 224), Kameran I., D. Thompson. (Lewis, 1945 : 10). W. ADEN PROT. Aden, all the year round (as *Stegomyia fasciata* Fabricius, Smith & Loughnan, 1914 : 706, as *Aë. aegypti*, Petrie & Seal, 1943 : 83), Steamer Point, 11.ix.1911 and 10.x–1.xii.1912, A. Dawson (Edwards, 1941 : 130). W. SAUDI ARABIA. Mecca, B. es Sayed (Lewis, 1945 : 10), Jedda (Brunelli, 1936), 25.x.1936, F. P. Mackie, 6.xi.1949, N. L. Corkill (B.M.). E. ADEN PROT. Amd, ii.1952, N. L. Corkill, Tarim, v.1952, L. Merucci (Mattingly, 1953*a* : 60), Aiyad, 19.iv.1953, Rukub,

Harshiyat, Al-Ais, Fewa and Burum, iii.1953, N. L. Corkill (Mattingly, 1953*b* : 296), Al-Beidha, Dis Town, Geregeri, Hami, Wasita, 25.v.1953, Sukhal al-Dis, Urfat Subai, 24.v.1953, N. L. Corkill (Mattingly & Bruce-Chwatt, 1954 : 191), Mukalla and Rukub, iii.1952, Shihr, ii.1954, Shuabat Amudi (Wadi Amd), Hami al-Sharq, iv.1954, Rubat Bakhoban (Wadi Amd) and N'Air (Wadi Amd), i.1954, Mahfud (Wadi Irma) and Sahwa and Sana (both Wadi Rakhya), iv.1954, N. L. Corkill (B.M.). SOCOTRA. Ras Shoab, i.1899, O. Simony (Becker, 1931 : 140). BAHREIN. Unnamed locality, i.1906, A. Bennett (as *Stegomyia Fasciata* Fabricius, Giles, 1906 : 131, Edwards, 1941 : 130). TRUCIAL OMAN. Dubai, 19.iii.1944, C. M. Hopkins (L.S.H.). OMAN. Muscat, 1902, M. Biró (as *St. fasciata*, Theobald, 1905 : 73).

Note.—The pale form has been found in all the localities in the Eastern Aden Protectorate except Mukalla and Rukub. Knight (1953*b*) records a high proportion of pale forms among his Yemen specimens. Specimens in the British Museum from Jedda, Bahrein I. and Steamer Point, Aden, are also pale. The only specimens in the British Museum which can be assigned with any confidence to the dark form are a small number from Jedda and Mukalla.

Aëdes granti. SOCOTRA. Dahamis, 20.xii.1898, W. R. O. Grant (Theobald, 1901 : 306), Mouri, 10–16.xii.1942, G. F. W. Hart (Leeson & Theodor, 1948 : 226).

Aëdes vittatus. W. ADEN PROT. Aden, Nobat Dakim, Sheik Othman, Ulub, W. S. Patton (Patton, 1905 : 634), Jebel Jehaf (7,100 ft.), ix and x.1937, H. Scott and E. B. Britton, Aden Hinterland, 20.ii.1895,—. Yerbury (Edwards, 1941 : 155), Awabil, iv.1954, N. L. Corkill (B.M.). E. ADEN PROT. Wadiyain, 12.viii.1936, H. St.J. B. Philby (Edwards, 1941 : 155, Mattingly, 1952 : 256). SOCOTRA. Kallansiya, 4.i.1943, Hadibo, Kathub, G. F. W. Hart (Leeson & Theodor, 1948 : 227). Hadibo, ii.1954, N. L. Corkill (B.M.).

Aëdes arabiensis. W. ADEN PROT. Ulub, v.1904, Aden (in the crater), W. S. Patton (as *Culex arabiensis* sp. n., Patton, 1905 : 633, as *Aëdes vexans* Meigen, Edwards, 1921 : 323, as *Aë. arabiensis*, Edwards, 1941 : 195), Aden Hinterland, vi.1914, K. Chand (Edwards 1941 : 195). W. SAUDI ARABIA. Jedda, 1927, H. St.J. B. Philby (Edwards, 1941 : 195), Madruga, 26.x.1936, F. P. Mackie (B.M.).

Aëdes hirsutus var. *adenensis*. W. ADEN PROT. Jebel Jehaf (at about 7,100 ft.), ix.1937, H. Scott & E. B. Britton (Edwards, 1941 : 198), D'thala, ix.1937, H. Scott & E. B. Britton (B.M.).

Aëdes natronius. YEMEN. El-Hauban (Wadi el-Malah), 19.i.1951, Hamman 'Ali, 5.ii.1951, K. L. Knight, (Knight 1953*b* : 212).

Culex tigripes. YEMEN. Ta'izz, 12 and 18.i.1951, K. L. Knight, Usaifira, xii.1937, H. Scott and E. B. Britton (Knight, 1953*b* : 225). W. ADEN PROT. Jebel Jehaf (7,100 ft.), E. B. Britton (Edwards, 1941 : 249), D'thala, W. S. Patton (as *Culex concolor* Robineau Desvoidy, Patton, 1905 : 636). W. SAUDI ARABIA. Abah, 22.vii.1944, A. R. Waterston (B.M.).

Culex arbieeni. YEMEN. El-Hauban (Wadi el-Malah), 16.i.1951, Wadi Mal el-Ghail, 7.ii.1951, K. L. Knight (as *Culex jenkinsi* sp. n., Knight, 1953*a* : 324).

Culex salisburiensis. YEMEN. Wadi Grab (near Ma'abar), 6.ii.1951, K. L. Knight (Knight, 1953*b* : 226).

Culex sp. indet. YEMEN. El-Hauban (Wadi el-Malah), 19.i.1951, K. L. Knight (as ? *Culex jenkinsi* sp. n., Knight, 1953*b* : 225 (larva only)).

Culex nebulosus. YEMEN. Ta'izz, 17.i.1951, K. L. Knight (Knight, 1953*b* : 228).

Culex pusillus. E. SAUDI ARABIA. El-Ajam, 4.ix.1947, El-Kharj, 30.xii.1947, El-Khobar, 13.xii.1947, R. H. Daggy (U.S.N.M.), El-Kharj, 16–22.iii.1944, C. M. Hopkins (L.S.H.).

Culex decens. YEMEN. Ta'izz, 12 and 18.i.1951, K. L. Knight (Knight, 1953*b* : 229). W. ADEN PROT. Tor um Baha, P. W. R. Petrie (Petrie & Seal, 1943 : 80).

Culex duttoni. W. ADEN PROT. Mikhuras, x.1954 (B.M.).

Culex ethiopicus. YEMEN. Wadi Siham (near 'Obal), 4.ii.1951, K. L. Knight (Knight, 1953*b* : 229). W. ADEN PROT. D'thala, Hardeba, Nobat Dakim (as *Taeniorhynchus tenax* var. *maculipes arabiensis* var. nov., Patton, 1905 : 635), Wadi Ma'adin, 2–4.ii.1940, P. W. R. Petrie (Edwards, 1941 : 292), Tor um Baha, P. W. R. Petrie (Petrie & Seal, 1943 : 80).

Culex laticinctus. YEMEN. Ta'izz, 18.i.1951, K. L. Knight (Knight, 1953*b* : 229). W. ADEN PROT. Awabil and Khalla, iv.1954, N. L. Corkill (B.M.), Mikhuras, x.1954 (B.M.). W. SAUDI ARABIA. Shi Aera (near Qunfida), W.H.O. Malaria Team (L.S.H.), Buraiman, 22.i.1946, E. S. Brown (B.M.), Hima, 22.vi.1936, H. St.J. B. Philby (Edwards, 1941 : 314). E. ADEN PROT. N'air, Anag, Khirbat Bakarman, Amd Town, Nafhun, Shuabat Amudi (all Wadi Amd), Rubat Bakhoban, Hajrein (Wadi Duan), all i.1954, Geidun (Wadi Laiser) and Sana (Wadi Rakhya), iv.1954, N. L. Corkill (B.M.). SOCOTRA. Mouri, 13 and 20.xii.1942, Hadibo, 11 and 13.xii.1942, Kathub, 5 and 13.xii.1942, G. F. W. Hart (Leeson & Theodor, 1948 : 228), Kallansiya, 15.i.1943, G. F. W. Hart (L.S.H.). OMAN. Muscat, 1915, C. A. Gill (Edwards, 1921 : 342).

Culex mattinglyi. YEMEN. Birket Shiekh Kunnaf, 13.ii.1951, Wadi Dhahr, 11 and 13.ii.1951, Rouda, 15.ii.1951, San'a, 12.ii.1951, K. L. Knight (Knight, 1953*a* : 322), San'a, 29.i.1938, –.ii.1938, 9.ii.1938 and –.iii.1938, H. Scott and E. B. Britton (as *Culex laticinctus*, Edwards, 1941 : 314, as *Culex mattinglyi*, Knight, 1953*b* : 229). W. SAUDI ARABIA. Dhahran, 22.vi.1936, H. St.J. B. Philby (as *Culex laticinctus*, Edwards, 1941 : 314).

Culex pipiens. YEMEN. Ta'izz, 21.i.1951, Hammam 'Ali, 5.ii.1951, K. L. Knight, Hada, 14.i.1938, San'a, i and ii.1938, H. Scott and E. B. Britton (Knight, 1953*b* : 230). W. ADEN PROT. D'thala, Nobat Dakim, Hardeba, Jebel Jehaf above 7,000 ft., W. S. Patton (Patton, 1905 : 635), Am Riga, W. S. Patton (Patton, 1905 : 627), Mikhuras, x.1954 (B.M.). W. SAUDI ARABIA. Taif, 31.x.1936, F. P. Mackie (B.M.). E. ADEN PROT. Seiyun, ii.1952, N. L. Corkill (B.M.). E. SAUDI ARABIA. El-Kharj, i and ii.1948, R. H. Daggy (U.S.N.M.), El-Kharj, 16–22.ii.1944, C. M. Hopkins (L.S.H.), Hoffuf, ii.1944, C. M. Hopkins (Hopkins, MS.). TRUCIAL OMAN. Khars, 23.iii.1944, C. M. Hopkins (L.S.H.).

Culex pipiens ssp. *fatigans.* YEMEN. Murawah, 30.i.1951, K. L. Knight (as *Culex quinquefasciatus* Say, Knight, 1953*b* : 230). W. ADEN PROT. Practically everywhere including Jebel Jehaf (Patton, 1905 : 635), Lahej, x : 1935, R. C. M. Darling (B.M.), D'thala, W. S. Patton (Patton, 1905 : 636), Aden, all the year round (Smith & Loughnan, 1914 : 706), Shuqra, P. W. R. Petrie (Petrie & Seal, 1943 : 80),

Aden, 1913, W. F. M. Loughnan. (B.M.). W. Saudi Arabia. Jedda, 25.x.1936, F. P. Mackie, 21.ix.1948 and –.ix.1949, N. L. Corkill, Mecca, 16.x.1936 and 1.xi.1936. F. P. Mackie (B.M.). E. Aden Prot. Wadi Duan, xi.1935, R. C M. Darling, Rubat Bakhoban and N'Air (Wadi Amd), i.1954, N. L. Corkill (B.M.). Socotra. Hayoo, 7.i.1943, Kathub 5 and 6.xii.1942, Mouri, 16.xii.1942, Kallansiya, Hadibo (Leeson & Theodor, 1948 : 228), Hadibo, ii.1954, N. L. Corkill (B.M.). Bahrein. Unnamed locality, i.1906, A. Bennett (Giles, 1906 : 131). Trucial Oman. El-Kelba, 30.iii.1944, C. M. Hopkins (L.S.H.). Oman. Salalah, 1 29.xi. 1953, M. J. Gavin (U.S.N.M.).

Culex pipiens var. molestus. W. Saudi Arabia. Jedda, 25.x.1936, F. P. Mackie (B.M.).

Culex simpsoni. Yemen. El-Hauban (Wadi el-Malah), 16.i.1951, K. L. Knight (Knight, 1953*b* : 230).

Culex sinaiticus. Yemen. Wadi Raidan, 25.i.1951, Wadi Siham (near 'Obal), 4.ii.1951, K. L. Knight (Knight, 1953*b* : 231). W. Aden Prot. Wadi Ma'adin, 2.ii.1940, P. W. R. Petrie (Edwards, 1941 : 311), Tor um Baha, P. W. R. Petrie (Petrie & Seal, 1943 : 80). E. Aden Prot. Harshiyat, iii : 1953, N. L. Corkill (B.M.). Socotra. Mouri, 13.i.1943 Kathub, 5 and 6.xii.1942, Hadibo (Leeson & Theodor, 1948 : 228), Hadibo, ii : 1954, N. L. Corkill (B.M.). E. Saudi Arabia. Saihat, 26.ix.1947, R. H. Daggy (U.S.N.M.). Oman. Muscat, 1915, C. A. Gill (B.M.).

Culex sitiens. Yemen. Hodeida, iii.1938, H. Scott and E. B. Britton, 28, 29 and 31.i and 4.ii.1951, K. L. Knight (Knight, 1953*b* : 231. W. Aden Prot. Aden, 1913, W. F. M. Loughnan, Shuqra, P. W. R. Petrie (Petrie & Seal, 1943 : 80). W. Saudi Arabia. Jedda, 1936, F. P. Mackie, 1927, H. St.J. B. Philby (Edwards, 1941 : 298). E. Aden Prot. Wadi Maseila, 8.xii.1934, H. Ingrams (Edwards, 1941 : 298), Harshiyat, Buaish, Al-Ais, Burum, Thilla, all iii.1953, Shihr, ii.1954, Khon (Wadi Maseila), vii.1953, Gheil Bawazir, Hami al-Sharq and Mukalla, all iv.1954, Wasita, Hami, Al-Beidha, Dis Town, Geregeri, 25.v.1953, Urfat Subhai, Sukhal al-Dis, 24.v.1953, N. L. Corkill (B.M.). Socotra. Ras Shoab, i.1899, O. Simony (as *Culex annulus* Theobald, Becker, 1931 : 140), Mouri, 16.xii.1942, Khor Hadjun, 7–12.xii.1942, Kathub, 6.xii.1942, G. F. W. Hart (Leeson & Theodor, 1948 : 227). Trucial Oman. Abu Dhubi and Sharja, 21.iii.1944, El-Kelba, 30.iii.1944, C. M. Hopkins (L.S.H.). Oman. Salalah, 19.xi.1953, M. J. Gavin (B.M.).

Culex theileri. Yemen. El-Amra, 9.i.1951, El-Hauban (Wadi elMalah) 16 and 19.i.1951, Birket Ghail Masnah, 5.ii.1951, Birket Ma'agel Biet Myiad, 12.ii.1951, K. L. Knight, Hada, i.1938, H. Scott and E. B. Britton, San'a, x.1937, C. Rathjens, i.1938, H. Scott and E. B. Britton (Knight, 1953*b* : 232). W. Aden Prot. Jebel Jehaf, 7,100 ft., ix.1937, H. Scott and E. B. Britton (Edwards, 1941 : 306), Mikhuras, x.1954 (B.M.).

Culex tritaeniorhynchus. Yemen. Wadi Siham (near 'Obal), 4.ii.1951, K. L. Knight (Knight, 1953*b* : 232). E. Aden Prot. Hauta (Hajr), 24.iv.1953, Dis Town, 25.v.1953, Urfat Subai, 24.v.1953, N.L. Corkill (B.M.). Socotra. Kathub, 4–25.xii.1942, G. F. W. Hart (as *Culex thalassius* Theobald, Leeson & Theodor,

1948 : 228), Kallansiya, 5.i.1943, G. F. W. Hart (B.M.), Wadi Maurio, 17.i.1943, G. F. W. Hart (L.S.H.). E. SAUDI ARABIA. El-Ajam, ix.1947, El-Khobar, x and xii.1947, Saihat, 26.ix.1947, R. H. Daggy (U.S.N.M.). OMAN. Salalah, 26.xi.1953, M. J. Gavin (B.M.).

Culex univittatus. YEMEN. Usaifira (near Ta'izz), 13.xii.1937, H. Scott and E. B. Britton (as *C. univittatus* var. *neavei* Theobald, Knight, 1953*b* : 233). OMAN. Se'harr, 1.iv.1944, El-Kelba, 30.iii.1944, C. M. Hopkins (L.S.H.).

LIST OF LOCALITIES

Most of the localities in the Yemen were visited by one of us (K. L. K.). For details of localities in the Eastern Aden Protectorate we are indebted to Dr. N. L. Corkill. Details of a number of Philby's localities are given in Philby (1952), of Thomas's in Thomas (1931) and of Patton's in Patton (1905). Apart from this we have relied mainly on maps and on the admirable series of geographical handbooks prepared by the Naval Intelligence Division in London. In the case of wadis the latitude and longitude given are approximately those of the middle of their course. The altitudes given for Jebel el-Scharr and Jebel Jehaf are those of their summits.

Locality.	Approximate altitude (ft.).	Approximate latitude and longitude. N.	E.
A'aith, Socotra	—	Not Located.	
Abah (Abha), W. Saudi Arabia	8,000	18° 0′	42° 30′
Abu Dhubi, Trucial Oman	<500	24° 15′	54° 33′
Abyan, W. Aden Prot.	<500	13° 5′	45° 20′
Aden, W. Aden Prot.	<500	12° 45′	45° 4′
Aina, Yemen	4,500	17° 45′	43° 15′
Ain Rohem, E. Saudi Arabia	—	Not Located.	
Aiyad, E. Aden Prot.	3,000	15° 0′	46° 50′
Al-Ais, E. Aden Prot.	<500	Mukalla area.	
Al-Anad, W. Aden Prot.	<500	13° 15′	45° 0′
Al-Beidha, E. Aden Prot.	<500	14° 50′	49° 50′
Al-Hadba, E. Aden Prot.	<500	Near Mukalla.	
Amd Town, E. Aden Prot.	3,100	15° 30′	48° 10′
Am Riga, W. Aden Prot.	1,000	13° 0′	44° 35′
Anag, E. Aden Prot.	3,000	15° 35′	48° 13′
Anaiza, E. Saudi Arabia	2,000	26° 9′	44° 10′
Arad, Bahrein	<500	Not Located.	
Awabil, W. Aden Prot.	6,500	13° 50′	44° 50′
Azriki, W. Aden Prot.	5,000	13° 45′	44° 40′
Baremie, Oman	1,000	23° 58′	55° 59′
Basaitin, Bahrein	500	26° 17′	50° 36′
Birket Ghail Masnah, Yemen	7,300	14° 20′	44° 20′
Birket Ma'agel-Biet Myiad, Yemen	7,100	15° 20′	44° 10′
Birket Shiekh Kunnaf, Yemen	7,100	See San'a.	
Bir Said Ali, W. Aden Prot.	<500	13° 5′	45° 0′
Buaish, E. Aden Prot.	<500	14° 35′	49° 20′
Buraiman, W. Saudi Arabia	<500	21° 35′	39° 12′
Burum, E. Aden Prot.	<500	14° 20′	48° 50′
Dahamis (Wadi), Socotra	1,500	12° 30′	54° 10′
Dammam, E. Saudi Arabia	<500	26° 15′	50° 5′

Locality.	Approximate altitude (ft.).	Approximate latitude and longitude. N.	E.
Dar al-A'mir, W. Aden Prot.	<500	12° 55′	45° 0′
Darsait, Oman	<500	23° 38′	58° 32′
Devil's Creek, Socotra	—	Not Located.	
Dhahran, W. Saudi Arabia	6,000	17° 30′	44° 0′
Dhamar, Yemen	7,400	14° 32′	44° 27′
Diraz, Bahrein	<500	26° 13′	50° 28′
Dis Town, E. Aden Prot.	<500	14° 50′	49° 50′
Dmeith, Trucial Oman	—	Not Located.	
D'thala, W. Aden Prot.	4,800	13° 41′	44° 45′
Dubai, Trucial Oman	<500	24° 52′	55° 15′
El-Ajam, E. Saudi Arabia	<500	26° 33′	49° 57′
El-Amra, Yemen	3,500	13° 40′	44° 0′
El-Hauban, Yemen	3,700	13° 34′	44° 6′
El-Kelba, Trucial Oman	<500	25° 1′	56° 20′
El-Kharj, E. Saudi Arabia	1,000	23° 51′	47° 28′
El-Khobar, E. Saudi Arabia	<500	26° 6′	50° 9′
El-Waht, W. Aden Prot.	<500	13° 0′	45° 0′
Fewa, E. Aden Prot.	<500	14° 30′	49° 0′
Gaixan, Oman	?	Near Muscat.	
Galali, Bahrein	<500	26° 18′	50° 40′
Geidun, E. Aden Prot.	900	15° 30′	48° 25′
Geregeri, E. Aden Prot.	<500	14° 50′	49° 50′
Gheil Bawazir, E. Aden Prot.	<500	14° 48′	49° 20′
Goor, Socotra	?	12° 30′	54° 15′
Hada, Yemen	8,000	15° 20′	44° 10′
Hadibo, Socotra	<500	12° 37′	54° 5′
Hajrein, E. Aden Prot.	3,000	15° 30′	48° 25′
Hami, E. Aden Prot.	<500	14° 45′	48° 45′
Hami al-Sharq, E. Aden Prot.	<500	14° 40′	49° 40′
Hamman 'Ali, Yemen	5,000	14° 40′	44° 10′
Hardeba, W. Aden Prot.	4,000	13° 30′	44° 47′
Harshiyat, E. Aden Prot.	<500	14° 35′	49° 10′
Haski, W. Aden Prot.	<500	13° 5′	44° 50′
Hauta (Hajr), E. Aden Prot.	<500	14° 25′	48° 10′
Hayoo, Socotra	<500	12° 38′	53° 37′
Hima, W. Saudi Arabia	4,000	18° 0′	44° 20′
Hiswa, W. Aden Prot.	2,000	15° 40′	47° 50′
Hodeida, Yemen	<500	14° 48′	42° 55′
Hoffuf, E. Saudi Arabia	<500	25° 23′	49° 30′
Huweimi, W. Aden Prot.	3,000	13° 23′	44° 29′
Jadaliya, W. Saudi Arabia	6,200	17° 25′	43° 40′
Jebel el-Scharr, W. Saudi Arabia	9,000	27° 30′	35° 45′
Jebel Jehaf, W. Aden Prot.	7,500	13° 45′	44° 40′
Jedda, W. Saudi Arabia	<500	21° 32′	39° 10′
Jizwal, E. Aden Prot.	<500	14° 40′	48° 45′
Jol Bahawa, E. Aden Prot.	<500	14° 28′	48° 24′
Jurbaib, Oman	<500	17° 0′	54° 0′
Kallansiya, Socotra	<500	12° 39′	53° 38′
Kameran I., Yemen	<500	15° 25′	42° 35′
Kathub, Socotra	<500	12° 36′	54° 0′

Locality.	Approximate altitude (ft.).	Approximate latitude and longitude. N.	E.
Katif, E. Saudi Arabia	<500	26° 32′	50° 1′
Khalla, W. Aden Prot.	800	13° 30′	44° 50′
Khars (? Khurus), Trucial Oman	1,000	24° 15′	56° 0′
Khirba, E. Aden Prot.	<500	14° 30′	48° 55′
Khirbat Bakarman, E. Aden Prot.	3,000	15° 20′	48° 10′
Khon, E. Aden Prot.	500	16° 10′	49° 10′
Khor Hadjun, Socotra	<500	12° 33′	53° 53′
Kirsh, W. Aden Prot.	3,000	13° 22′	44° 30′
Kod, W. Aden Prot.	<500	13° 5′	45° 20′
Lahej, W. Aden Prot.	<500	13° 3′	44° 53′
Madaneya, W. Saudi Arabia	2,000	Medina area.	
Madinat el-Abid, Yemen	4,000	14° 40′	43° 59′
Madruga, W. Saudi Arabia	2,000	22° 0′	40° 0′
Mahfud, E. Aden Prot.	3,000	15° 20′	47° 10′
Manama, Bahrein	<500	26° 14′	50° 33′
Mecca, W. Saudi Arabia	2,000	21° 25′	39° 54′
Mehmida, E. Aden Prot.	500	14° 28′	48° 50′
Meifa, E. Aden Prot.	500	14° 20′	48° 50′
Mikhuras, W. Aden Prot.	6,000	14° 0′	46° 0′
Mouri, Socotra	<500	12° 36′	53° 59′
Muharrak, Bahrein	<500	26° 16′	50° 36′
Mukalla, E. Aden Prot.	<500	14° 31′	49° 8′
Murawah, Yemen	<500	14° 50′	43° 25′
Muscat, Oman	<500	23° 37′	58° 36′
Museimir, W. Aden Prot.	3,000	13° 27′	44° 37′
Nafhun, E. Aden Prot.	3,000	15° 28′	48° 7′
N'Air, E. Aden Prot.	3,000	15° 32′	48° 12′
Nee, Socotra	?	12° 27′	54° 16′
Nobat Dakim, W. Aden Prot.	1,100	13° 15′	44° 40′
Qaidun, E. Aden Prot.	3,000	15° 20′	48° 20′
Qoreina, W. Aden Prot.	3,000	13° 23′	44° 30′
Ras el-Khamar, Trucial Oman	<500	25° 50′	56° 0′
Ras Shoab, Socotra	<500	12° 30′	53° 30′
Ras Tanura, E. Saudi Arabia	<500	26° 40′	50° 5′
Rifa a-Ash Sharqi, Bahrein	<500	26° 7′	50° 34′
Rouda, Yemen	7,100	15° 24′	44° 12′
Rubat Bakhoban, E. Aden Prot.	3,000	15° 20′	48° 10′
Rukub, E. Aden Prot.	<500	14° 30′	49° 15′
Safwa, E. Saudi Arabia	<500	26° 40′	49° 58′
Sahwa, E. Aden Prot.	2,000	15° 40′	47° 50′
Saihat, E. Saudi Arabia	<500	26° 10′	50° 5′
Sakhir, Bahrein	<500	26° 1′	50° 31′
Salalah, Oman	<500	17° 0′	54° 6′
Salim, W. Aden Prot.	<500	12° 50′	44° 55′
Sana, E. Aden Prot.	2,000	15° 40′	47° 50′
San'a, Yemen	7,100	15° 22′	44° 12′
Se'harr (? Sohar), Oman	<500	24° 23′	56° 45′
Seiyun, E. Aden Prot.	2,300	15° 57′	48° 47′
Sharja, Trucial Oman	<500	25° 9′	55° 33′
Sheikh 'Othman, W. Aden Prot.	<500	12° 53′	45° 3′

Locality.	Approximate altitude (ft.).	Approximate latitude and longitude. N.	E.
Shi Aera, W. Saudi Arabia		Near Qunfida.	
Shibam, E. Aden Prot.	2,500	15° 56′	48° 37′
Shihr, E. Aden Prot.	<500	14° 43′	49° 33′
Shinas, Oman	<500	24° 27′	56° 35′
Shuabat Amudi, E. Aden Prot.	3,000	15° 20′	48° 10′
Shuqra, W. Aden Prot.	<500	13° 20′	45° 50′
Sidab, Oman	<500	23° 36′	58° 36′
Sidara, E. Aden Prot.	500	14° 30′	48° 8′
Steamer Point, W. Aden Prot.		See Aden.	
Sukhal al-Dis, E. Aden Prot.	<500	14° 50′	49° 50′
Suleimiya, E. Saudi Arabia	1,000	24° 0′	47° 30′
Sulek, W. Aden Prot.	1,500	13° 30′	44° 50′
Taif, W. Saudi Arabia	6,200	21° 17′	40° 22′
Ta'izz, Yemen	4,100	13° 34′	44° 3′
Tarfaa, W. Saudi Arabia	500	21° 20′	39° 30′
Tarim, E. Aden Prot.	2,200	16° 2′	49° 0′
Thilla, E. Aden Prot.	<500	Near Mukalla.	
Tor um Baha, W. Aden Prot.	1,500	13° 5′	44° 20′
Ulub, W. Aden Prot.	3,000	13° 30′	44° 42′
Urfat Subai, E. Aden Prot.	<500	14° 50′	49° 50′
Usaifira, Yemen	4,000	13° 35′	44° 2′
Wadi Bait al-Falaj, Oman	<500	23° 36′	58° 32′
Wadi Dhahr, Yemen	7,000	15° 20′	44° 0′
Wadi Duan, E. Aden Prot.	3,000	15° 30′	48° 20′
Wadi Grab, Yemen	7,300	14° 40′	44° 25′
Wadi Hidaba, W. Aden Prot.	3,000	13° 20′	44° 30′
Wadi Killiem, Socotra		Not located.	
Wadi Liya, W. Saudi Arabia	<500	17° 0′	43° 0′
Wadi Ma'adin, W. Aden Prot.	1,500	13° 5′	44° 20′
Wadi Mal el-Ghail, Yemen	6,500	14° 50′	44° 0′
Wadi Maseila, E. Aden Prot.	<500	15° 50′	50° 0′
Wadi Maurio, Socotra		Not located.	
Wadi Natid, W. Aden Prot.	3,000	13° 30′	44° 30′
Wadi Raidan, Yemen	3,000	13° 30′	43° 50′
Wadi Rishan, Yemen		Not located.	
Wadi Siham, Yemen	1,000	14° 50′	43° 30′
Wadi So'lu, Yemen		Not located.	
Wadi Tiban, W. Aden Prot.	1,000	13° 15′	44° 45′
Wadi Tintern, Socotra	500	12° 30′	54° 10′
Wadi Worazan, Yemen	3,500	13° 30′	44° 25′
Wadiyain, W. Aden Prot.	1,000	15° 30′	47° 0′
Wasita, E. Aden Prot.	<500	14° 50′	49° 50′

ZOOGEOGRAPHY

General considerations.

The Arabian peninsula, together with North Africa, forms the meeting place of the Palaearctic and Ethiopian zoogeographical regions. Early zoogeographers such as Wallace and Sclater owned to an almost total ignorance of the Arabian fauna and

compromised by drawing the boundary between the two regions as a line running due east and west half way down the peninsula (Wallace) or treating the whole peninsula as Ethiopian (Sclater). Chapin (1923 : 121) substituted a line approximately defining the high ground in the south-west of the peninsula and running south-east from the neighbourhood of Jedda to reach the coast, opposite the Kuria Muria Islands, in Oman. This line was slightly modified at its eastern end by Chapin (1932 : 90). It was based on the distribution of the Arabian birds but was accepted by Edwards (1941 : 452) for the mosquitoes. It is shown in Text-fig. 4 (p. 115). It will be seen that most of western Saudi Arabia lies north and east of the boundary in the Palaearctic Region. Conversely a part of Oman, including Dhufar, lies to the west of the boundary in the Ethiopian Region. One of the most unfortunate gaps in our knowledge is the complete absence of any mosquito records from the Qara Mountains in Dhufar. As it is, our only records from this territory are from coastal localities (*Culex pipiens fatigans*, *C. sitiens* and *C. tritaeniorhynchus* from Salalah and *Anopheles coustani* var. *tenebrosus* from Jurbaib). All four forms are widely distributed in both major regions, but the last is known only from eastern and not from western Arabia. and this inclines us to question the propriety of extending the boundary so far east. Aside from this it is in good accordance with the distribution of the mosquitoes in so far as it is known to us.* Since almost all our records from western Saudi Arabia come from within or very near to the Ethiopian portion of that territory and only the Dhufar records come from outside the Palaearctic portion of Oman, it is convenient for the purpose of the present paper to treat western Saudi Arabia, the Yemen and the eastern and western Aden Protectorates as Ethiopian and the remaining political divisions of the peninsula as Palaearctic (Table I, p. 127). The island of Socotra has one endemic species, a number of species common to both major regions and one subspecies (*An. culicifacies adenensis*) which is wholly, or almost wholly, Ethiopian. It was included by Edwards (1941) in the Ethiopian Region but we have preferred to treat it as Palaearctic since several of its species (*Anopheles dthali*, *Aëdes caspius*, *Culex laticinctus* and *sinaiticus*), although admittedly having a restricted distribution in the Ethiopian Region, are mainly Palaearctic, while none (other than *An. adenensis*) can be said to be predominantly Ethiopian. The affinities of the endemic species, *Aëdes granti* are somewhat obscure (Mattingly, 1953 : 17) but they are certainly not Ethiopian.

The Ethiopian element in the fauna

Table I shows the Arabian mosquitoes grouped according to the main political divisions in which they occur and gives a rough picture of the composition of the Palaearctic and Ethiopian elements in the fauna and the extent to which they intermingle. The picture thus diagrammatically presented is, however, misleading in certain respects. This is so mainly because it fails to take sufficient account of the occurrence in the Ethiopian fauna itself of numerous Palaearctic intrusions. Thus *Anopheles multicolor* and *turkhudi* and *Culex molestus* are known only from a restricted area in the extreme north-eastern corner of the Ethiopian Region and are widely

* Meinertzhagen (1954 : 33) prefers to treat the whole peninsular as Palaearctic, but with this we cannot agree.

TABLE I.—*Distribution of the Arabian mosquitoes.*

Species.	Ethiopian.				Palaearctic.				
	Yemen.	W. Aden Prot.	W. Saudi Arabia.	E. Aden Prot.	Socotra.	E. Saudi Arabia.	Bahrein.	Trucial Oman.	Oman.
Aëdes natronius	×	—	—	—	—	—	—	—	—
Culex arbieeni	×	—	—	—	—	—	—	—	—
Culex salisburiensis	×	—	—	—	—	—	—	—	—
Culex sp. indet.	×	—	—	—	—	—	—	—	—
Culex nebulosus	×	—	—	—	—	—	—	—	—
Culex mattinglyi	×	—	—	—	—	—	—	—	—
Culex simpsoni	×	—	—	—	—	—	—	—	—
Anophles demeilloni	×	×	—	—	—	—	—	—	—
Anopheles pretoriensis	×	×	—	—	—	—	—	—	—
Aëdes hirsutus var. adenensis	—	×	—	—	—	—	—	—	—
Culex decens	×	×	—	—	—	—	—	—	—
Culex duttoni	—	×	—	—	—	—	—	—	—
Culex ethiopicus	×	×	—	—	—	—	—	—	—
Culex theileri	×	×	—	—	—	—	—	—	—
Anopheles coustani t.f.	—	—	×	—	—	—	—	—	—
Anopheles cinereus	×	×	×	—	—	—	—	—	—
Anopheles pharoensis	×	—	×	—	—	—	—	—	—
Anopheles turkhudi	×	×	×	—	—	—	—	—	—
Aëdes arabiensis	—	×	×	—	—	—	—	—	—
Culex tigripes	×	×	×	—	—	—	—	—	—
Culex pipiens var. molestus	—	—	×	—	—	—	—	—	—
Anopheles gambiae	×	×	×	×	—	—	—	—	—
Anopheles rhodesiensis rupicolus	×	×	—	×	—	—	—	—	—
Aëdes caballus	—	—	—	×	—	—	—	—	—
Aëdes vittatus	—	×	—	×	×	—	—	—	—
Anopheles sergenti	×	—	×	×	—	×	×	—	—
Anopheles culicifacies adenensis	×	×	—	—	×	—	—	×	—
Anopheles multicolor	—	—	×	—	—	×	—	×	—
Culiseta longiareolata	×	×	×	—	—	×	—	×	—
Culex pipiens t.f.	×	×	×	×	—	×	—	×	—
Aëdes aegypti	×	×	×	×	×	—	×	×	×
Anopheles dthali	×	×	×	×	×	—	—	—	×
Culex laticinctus	×	×	×	×	×	—	—	—	×
Culex pipiens fatigans	×	×	×	×	×	—	×	×	×
Culex sinaiticus	×	×	—	×	×	×	—	—	×
Culex sitiens	×	×	×	×	×	—	—	×	×
Culex tritaeniorhynchus	×	—	—	×	×	×	—	—	×
Aëdes granti	—	—	—	—	×	—	—	—	—
Culex pusillus	—	—	—	—	—	×	—	—	—
Anopheles pulcherrimus	—	—	—	—	—	×	×	—	—
Aëdes caspius	—	—	—	—	×	×	×	—	—
Anopheles coustani tenebrosus	—	—	—	—	—	×	—	—	×
Anopheles culicifacies t.f.	—	—	—	—	—	—	×	×	×
Anopheles fluviatilis	—	—	—	—	—	×	×	—	×
Anopheles stephensi	—	—	—	—	—	×	×	×	×
*Culex univittatus**	×	—	—	—	—	—	—	—	×

* It is probable that *C. univittatus* is represented by the type form in the Yemen and by var. *perexiguus* Theobald in Oman. If this should prove to be the case then the type form would be listed after *C. simpsoni*, the variety remaining at the foot of the table.

distributed outside it. These cannot be regarded as Ethiopian species in any sense of the term. Nor in our view can *Culex arbieeni* with its remarkable discontinuous distribution in both regions and its predominantly Palaearctic affinities (*infra*, p. 135, and see Mattingly, 1955*b*). Borderline cases include *Culex theileri*, *Anopheles rhodesiensis rupicolus* and *Aëdes vittatus*. *C. theileri* is very widely distributed in the Mediterranean Sub-region of the Palaearctic. In the Ethiopian Region it is confined to the eastern highlands and to South Africa and it might be regarded either as a Palaearctic intruder which has spread southwards or as a south African species which has spread northwards along the East African Highlands. *Anopheles rupicolus* has only a restricted distribution in the north-eastern corner of the Ethiopian Region, but its distribution in the Palaearctic is also very restricted and it is, in fact, known there only as isolated relict populations from the Sinai Peninsula and the Kuweira Upland in Transjordan (Lumsden in Leeson *et al.*, 1950 : 83). *Aëdes vittatus* is very widely distributed in the Ethiopian Region and has only a very limited distribution in the Palaearctic (Tel of Algeria, Spain, Balearic Is., Corsica and the eastern end of the French Pyrenees). It is, however, widely distributed in the Oriental Region (for details see Mattingly, 1952 : 292). *Aëdes caballus* is a predominantly Ethiopian species widely distributed in East and South Africa. It is, however, largely coastal over much of its range and is known also from the eastern shore of the Gulf of Oman (Djask). *Anopheles pharoensis* is also widely distributed in the Ethiopian Region. It occurs outside it only in Egypt and Palestine. Endemic Arabian species include *Aëdes arabiensis*, *Culex mattinglyi* and *Culex sp. indet.* The affinities of the two latter are doubtful, but they are perhaps Ethiopian. *Aë. arabiensis* undoubtedly has Palaearctic affinities. It is a close relative of the Holarctic, Oriental and Australasian *Aëdes vexans* Meigen which occurs nowhere in the Ethiopian Region. It may be compared to *Culex salisburiensis* which is widely distributed in East and South Africa and is purely Ethiopian in its range although it is closely related to the Palaearctic *Culex deserticola* Kirkpatrick. Summarizing this section of the fauna it may be said that the only purely Ethiopian species (other than Arabian endemics) which are found in Arabia are *Anopheles cinereus, demeilloni, gambiae* and *pretoriensis*, *Aëdes hirsutus* and *natronius* and *Culex tigripes, salisburiensis, nebulosus, decens, duttoni* and *ethiopicus*. We thus arrive at a minimum figure of twelve Ethiopian species out of a known total for the whole of Arabia of forty-two. Adding to these *Anopheles coustani, pharoensis* and *rhodesiensis*, *Aëdes arabiensis, caballus* and *vittatus* and *Culex mattinglyi* and *sp. indet.* we obtain an upper figure of twenty. Thus it may be said that the Ethiopian element makes up from about 30–45% of the Arabian mosquito fauna. When it is observed that all except one of these species (*Anopheles coustani*) are found exclusively to the south-west of Chapin's line it will be seen that there is ample justification for treating the area so defined as part of the Ethiopian Region.

The Oriental element in the fauna.

The Ethiopian element in the Arabian mosquito fauna, as here defined, is a large one. Nevertheless its size is, as we have indicated, liable to exaggeration by the inclusion of species which are mainly Palaearctic and have only a very limited

distribution in the Ethiopian Region. The same applies with even greater force to the Oriental element. Seventeen of the Arabian species penetrate to a greater or less extent into the Oriental Region and a number of these are often described as Oriental species. As Table II shows, however, this is, in many cases, grossly misleading and only *Anopheles culicifacies* and *fluviatilis* and *Culex tritaeniorhynchus* can be accepted unequivocally as Oriental in the sense that the major part of their range lies within that region. To them may perhaps be added *Anopheles stephensi*, but its wide distribution in India appears to be very nearly balanced by its equal abundance in Irak and southern Iran. *Anopheles turkhudi* is a borderline case, but it is restricted to western India and in terms of area the bulk of its range undoubtedly lies in the Palaearctic. *Aëdes aegypti* and *Culex pipiens fatigans* are cosmotropical forms which have been widely distributed by Man so that they cannot be considered in the present

TABLE II.—*Distribution of Arabian Mosquitoes Found also in the Oriental Region.*

Species	Mediterranean Subregion.	N. India.	Central & S. India.	Far East.
Anopheles dthali	×	×	—	—
Anopheles multicolor	×	×	—	—
Anopheles pulcherrimus	×	×	—	—
Anopheles sergenti	×	×	—	—
Culiseta longiareolata	×	×	—	—
Aëdes caspius	×	×	—	—
Culex theileri	×	×	—	—
Culex univittatus	×	×	—	—
Anopheles stephensi	×	×	×	—
Anopheles turkhudi	×	×	×	—
Anopheles culicifacies	×	×	×	×
Anopheles fluviatilis	×	×	×	×
Aëdes aegypti	×	×	×	×
Aëdes vittatus	×	×	×	×
Culex pipiens fatigans	×	×	×	×
Culex sitiens	×	×	×	×
Culex tritaeniorhynchus	×	×	×	×

context without certain reservations. The natural range of *Aëdes aegypti* would appear to be in the Ethiopian and Palaearctic Regions and that of *C. fatigans* possibly in the Oriental. *Culex sitiens* has also undoubtedly had its range extended by Man. Reasons are given below (p. 129) for supposing that its original area of distribution may have been in the south-eastern corner of the Palaearctic Regions. *Aëdes vittatus*, having separate Oriental, Ethiopian and Palaearctic populations, cuts across any arbitrary scheme of classification. Of the remaining species shown in Table II all are widely distributed outside the Oriental Region and have only a very limited distribution within it. They are either restricted to the extreme North-west of India (*Anopheles dthali, multicolor, sergenti, Aëdes caspius*) or spread eastwards from there along the Himalayan foothills (*Culiseta longiareolata, Culex theileri*) or have a limited southward extension into the United Provinces (*Anopheles pulcherrimus, Culex univittatus*). The Oriental element may thus be said to be represented

at the lower limit by three species (*Anopheles culicifacies, fluviatilis, Culex tritaeniorhynchus*) and to these *Anopheles stephensi, Culex sitiens* and *Culex fatigans* may be added giving an upper limit of six species or roughly 7½%–15% of the whole. Apart from *Culex fatigans* these species are mainly coastal with limited penetrations of the hinterland by *An. stephensi* in the Hoffuf area, *An. culicifacies adenensis* behind Aden and *Cu. tritaeniorhynchus* in the Yemen. To them may be added a rather dubious element in Socotra, represented by *Aëdes granti*, and another in the western highlands represented by *Anopheles turkhudi* and *Aëdes vittatus*. The latter may, however, well represent a simultaneous invasion of India and Arabia from the Palaearctic. With it may be associated *Culex tigripes* which, though now purely Ethiopian, has its only close relatives in the Oriental Region. The most strongly Oriental part of our area is the Bahrein Islands with three Oriental, three Palaearctic and two cosmotropical species. We have no reason to regard any part of the area as predominantly Oriental and are in agreement with the majority of zoogeographers who would choose as the boundary of the Oriental Region either the eastern frontiers of Afghanistan and Baluchistan (following Wallace) or the eastern frontier of Southern Irak and the mid-line of the Persian Gulf (following Sclater).

Unrecorded species from neighbouring territories

On the basis of the foregoing remarks and having regard to our knowledge of their bionomics a few suggestions may perhaps be hazarded as to those species not so far recorded from the Arabian area but which may possibly be found there. Among species known to occur both in India and in Africa south of the Sahara the majority are probably excluded by their rainfall and vegetational requirements (although some surprises may yet await us in the high Yemen). These include *Aëdes* (*Mucidus*) *scatophagoides* Theobald, *Aëdes* (*Stegomyia*) *unilineatus* Theobald and *albopictus* Skuse, the latter in the islands of the Malagasy subregion only, *Aëdes* (*Banksinella*) *lineatopennis* Ludlow and *Culex* (*Culex*) *bitaeniorhynchus* Giles. Of these the most likely to be found is, perhaps, *Aëdes unilineatus*, which is capable of a high degree of drought resistance (Mattingly, 1952 : 288, 1953*a* : 54). Most of the Eritrean Culicini listed by Lewis (1943) have been found in S.W. Arabia. Among those which have not, attention should perhaps be drawn to *Aëdes* (*Aëdimorphus*) *eritreae* Lewis which has an unknown larva. Ethiopian species extending into Egypt include *Culex* (*Culex*) *antennatus* Becker (which also occurs in Palestine) and (*Culex* (*Culex*) *poicilipes* Theobald, both of which might be found at least in the north. Of Palaearctic species. *Anopheles hyrcanus* and *superpictus* have already been mentioned (p. 92). Lumsden (in Leeson *et al.*, 1950 : 83) considers that there is a strong possibility that *Anopheles hispaniola* Theobald will be found in Saudi Arabia. This possibility is certainly worth bearing in mind, especially in view of the fact that the adults are probably indistinguishable on external characters from those of *Anopheles cinereus*. The larva would run down on our key with *An. cinereus* and *An. turkhudi*. It differs from both in having normal mouth brushes and in other respects (notably in the shape of the palmate hair leaflets) resembles *An. cinereus*. Although it has frequently been compared to and even synonymized with *Anopheles turkhudi* there can be almost no doubt that it is the Mediterranean analogue of *Anopheles cinereus*

which it closely resembles in all stages.* Failure to recognize this seems to have been due mainly to the omission by Puri (1931 : 62) of *An. cinereus* from his Subdivision IV, Group 6, to which it undoubtedly belongs. Further confusion was added by an unfortunate footnote by Edwards (in Evans, 1938 : 336) in which he synonymized *An. hispaniola* with *An. turkhudi*.This led to the omission of the former from several widely used keys. Finally Smart (1948 : 159) makes confusion worse confounded by keying *An. hispaniola* as though it has only one (instead of both) of the long mesopleural bristles feathered. Other Palaearctic species which may possibly be encountered in northern Arabia are *Culex* (*Neoculex*) *deserticola* Kirkpatrick and *Culex* (*Lasiosiphon*) *adairi* Kirkpatrick. The former is liable to confusion with *Culex salisburiensis* to which it is closely related. Both have been found in the North Galala Mountains in the eastern desert of Egypt. Species recorded from southern Irak, but not so far from Arabia, include *Culiseta* (*Culiseta*) *subochrea* Edwards and *Culex* (*Culex*) *vishnui* Theobald. *Culex* (*Neoculex*) *quettensis* Mattingly (1955*b*) from Baluchistan is perhaps also worth mentioning. Among Oriental species *Anopheles subpictus* has already been mentioned (p. 92). In view of the smallness of the Oriental element in the Arabian fauna it does not seem likely that many other true Oriental species will be encountered.

Distribution within the Arabia area.

Owing to the absence or extreme paucity of records from many parts of our area little can usefully be said on this subject. An interesting example of a restricted north-south distribution is afforded by *Anopheles multicolor* which has not been found further south than Jedda in the West and Trucial Oman in the East. This is a mainly desert species which is apparently excluded from the Yemen, on the one hand, and the Muscat hinterland, on the other, by their relatively heavy rainfall. *Anopheles sergenti* has a somewhat similar distribution ; and another comparable case is perhaps that of *Aëdes arabiensis*, which is known from the Aden hinterland and the Jedda area but not from the wetter area which lies in between. In contrast to this a number of Ethiopian species are known only from the Yemen and may well be confined to that area by their need for a relatively heavy rainfall. The problem of how these species reached the Yemen is an interesting one and it seems that some light might be thrown on it by a detailed study of *Anopheles pharoensis*. The Mediterranean and Ethiopian forms of this species appear to be geographically isolated at the present time and it may be that small differences could be detected and could be used in comparing the two forms with that occurring in the Yemen.

Concerning east-west distributions there is even less to be said. Most species common to both sides of the peninsula give the impression of having spread down from the north. *Anopheles culicifacies* and *Culex tritaeniorhynchus* may be thought to have spread westwards along the southern coast, possibly with the assistance of Man and the occurrence of *Aëdes caballus* at Djask (p. 128) might be thought to indicate an extension of range in the opposite direction. It could, however, well be a

* Raffaele (1954) arrives independently at a similar conclusion. He considers that two species are probably confused under the name *An. hispaniola*. It is hoped to discuss this matter in more detail in the second part of this paper.

human introduction. Light on this and other problems might well be shed by exploration of the Qara Mountains in Dhufar and the mountains behind Muscat. The mosquito fauna of both is entirely unknown.

The altitudinal distribution of certain species has points of interest, but again our knowledge is limited and we have no knowledge of altitudes above a thousand feet in Oman and Trucial Oman. On the western face of the central highlands of the Yemen, the southern face of the highlands of the Aden Protectorates and the Qara Mountains and the eastern face of the mountains of Oman rainfall may be expected to increase steadily with altitude and may be even more important than the temperature gradient in controlling the distribution of mosquitoes. It is not, therefore, surprising to find a number of Ethiopian species apparently restricted to high altitudes in Arabia although they occur down to sea level elsewhere. Knight (1953*b* : 214), following Petrie, gives an average rainfall of about 2½ in. for the coastal plain and 14–15 in. for the central highlands of the Yemen. The Rainfall Map of Eastern Africa (East African Forces No. 1518) shows over 30 in. for the central highlands eastwards from San'a to the neighbourhood of Tarim. This figure seems high, but in any event there do not appear to exist any continuous observations over a sufficient period of years to provide reliable normals. Drainage from the uplands may be expected to provide high subsoil and surface water levels at intermediate altitudes and thus to create vegetational and other conditions more suitable for mosquitoes than might be expected solely from a consideration of local rainfall. Species found at altitudes of 7,000 ft. or more include *Anopheles cinereus, demeilloni* and *sergenti, Culiseta longiareolata, Aëdes vittatus* and *hirsutus, Culex tigripes, salisburiensis, mattinglyi, pipiens* and *theileri*. Most of these species have not been found below 3,500 ft. or more but *An. cinereus* has been found down to 1,500 ft. and *An. sergenti, Culiseta longiareolata* and *Aë. vittatus* down to sea-level. This extensive altitudinal range can be parallelled in the case of the two last species in the Ethiopian part of their range. Species occurring at intermediate altitudes (from 1,000 ft. to 6,500 ft.) include *An. coustani* t.f., *dthali, gambiae, pharoensis pretoriensis,* and *rupicolus, Aë. caballus* and *natronius* and *Culex arbieeni*, sp. *indet. nebulosus, decens, duttoni, ethiopicus, laticinctus, simpsoni, sinaiticus* and *univittatus*. Most of these species appear to be unable to exist in the very arid coastal plain, but *An. dthali* and *gambiae* and *Culex laticinctus, sinaiticus* and *univittatus* (Oman form) have been found down to sea-level. All these five species have been recorded as utilizing artificial collections of water (wells, cisterns, tanks, basins, temporary pools) in other parts of their range. It is remarkable that *C. duttoni* and *C. nebulosus* are not among their number, since elsewhere these species are markedly peridomestic. The remaining species are mostly confined to the coastal plain, but *An. multicolor* and *stephensi, Aë. caspius* and *Culex pusillus* are recorded from up to about 1,000 ft. and may go higher since we have no records from altitudes above this in the part of Arabia where they occur. *Culex tritaeniorhynchus* appears to go up to about 1,000 ft. in the Yemen (the only inland record from the Ethiopian part of its range) and *An. adenensis* penetrates up to about 500 ft. behind Aden. *Aëdes arabiensis* has not been clearly recorded from much above sea-level behind Aden, but it apparently goes up to 2,000 ft. further north. *Aëdes granti* was originally found in the " Dahamis Glen "

on Socotra and this appears to be at about 1,500 ft. It is possible that it is more abundant away from the coast, but our knowledge of the hill fauna of this island is extremely meagre. *Aëdes aegypti* is mainly coastal, as would be expected for the pale form, but it would seem that here, as elsewhere, there are exceptions (see Mattingly, 1953*a* : 46). The recorded altitudinal distribution of *C. pipiens pipiens* and *C. p. fatigans* behind Aden is anomalous, and one is led to suspect Patton of occasional misidentifications. If his records are accepted *C. p. fatigans* extends up to nearly 5,000 ft. (Dthala) and *C. pipiens* down to 1,100 ft. (Nobat). From a knowledge of their distribution elsewhere this seems somewhat unlikely (although not entirely out of court.) If the records are correct considerable overlapping occurs and this would be a good area in which to look for hybridization, but if the records from Dthala and Nobat are discounted then it is possible that they have a discontinuous distribution (*fatigans* up to 3,000 ft., *pipiens* down to 4,000 ft.).

The geological factor has been relatively little studied, but it is clearly very important in relation to mosquito distribution. In the Belgian Congo *Aëdes vittatus* is entirely confined to areas of ancient rocks and is absent from the sedimentary rocks of the Congo basin (Mattingly, 1954 : 51). This factor has not hitherto been studied in other parts of its range and it is interesting to find that in Arabia it is known only from the main area of igneous rocks in the west, the rocks of eastern Arabia being for the most part sedimentary. Unfortunately it is impossible to tell from the small-scale geological map available to us whether the same precise correlation holds good as in the Belgian Congo. The absence of *Aë. vittatus* from the Yemen is remarkable and it is perhaps worth noting that in similar country in central Spain it breeds in residual rock pools in the beds of torrential streams and has only a relatively short seasonal occurrence at the time when these are exposed but still water-filled. The Yemen has been the site of very intense volcanic activity, some of it continuing almost if not quite into recent times. It is not therefore surprising to find in that territory two species which appear to be particularly associated with volcanic conditions. *Aëdes natronius* is known with certainty from outside Arabia only from the highly volcanic area between Lake George and Lake Edward and from the neighbourhood of volcanic springs in Bwamba county, Uganda. Female adults of this species are not distinguishable with certainty from those of *Aëdes durbanensis* Theobald and it seems probable that the record of the latter species from Mt. Fantali in Abyssinia (Edwards, 1941 : 199) really refers to *Aë. natronius*. Conversely the record of *Aë. natronius* from Taveta in Kenya by Mrs. E. C. C. Van Someren (in Lumsden, 1955 : 161) probably refers to *Aë. durbanensis* which, although mainly a coastal species, has been recorded from inland localities in Tanganyika (Harris, 1942 : 183 ; Mattingly, 1954 : 59). The respective distributions of the two species require further investigation however. The point is an interesting one since it concerns the complex interrelationships between coastal, desert and plutonic mosquitoes, all of which are adapted to high concentrations of mineral salts in their breeding places. In this connection the close resemblance in certain features between the larvae of *Aëdes durbanensis, natronius, caballus, caspius, arabiensis, hirsutus* and *vittatus* (see above, p. 100) are worth noting, especially in view of the fact that these species are distributed, on adult characters, between three different subgenera.

The second Arabian species which may be tentatively associated with plutonic conditions is *Culex mattinglyi* (see Mattingly, 1954 : 58). Here, however, the association cannot be directly proved since this species has so far only been found in artificial breeding-places (details in Knight, 1953*b* : 216–217). This fact does not rule out the possibility of its occurrence in volcanic springs or pools, as is shown by the example of *Aëdes natronius*. The latter was originally found breeding in pools of extreme alkalinity and high temperature (Mattingly, 1954 : 59). Nevertheless larvae of the same species were found at the same time in fresh water nearby (Hopkins, 1952 : 207). Other instances could also be adduced to show that mosquitoes adapted to breeding in a specialized habitat and (as in the case of *Aë. natronius*) occurring in that habitat in very large numbers may " overflow " into more generalized habitats, even to the extent of supplanting the usual inhabitants over a limited area. This does not mean that such species are sufficiently plastic to become generally distributed, but it does argue a degree of plasticity which is not altogether negligible. In this connection, however, a word of warning is perhaps needed regarding the use of the term " fresh water ". In England *Aëdes caspius* is largely coastal in its distribution and it is undoubtedly capable of breeding in brackish water with a high degree of salinity. Nevertheless it occasionally appears in inland localities and there constitutes a serious nuisance. Only two such outbreaks have been thoroughly investigated (a third is being investigated at the present time) and in both these cases breeding has been found to be taking place in the purified effluents from sewage farms. Such effluents, although fresh in the sense of being free from organic contamination, frequently have a high chloride content. Callot and Dao-Van-Ty (1942) have a record from near Paris. In this case the breeding water was observed to have a high organic nitrogen content. The chloride content is not mentioned.* The wide distribution of this species in Central Europe (Edwards, 1921 : 300) suggests that this species is relatively plastic. Nevertheless over most of its range its presence appears to be associated with that of breeding waters having a high mineral salt content, whether as a result of proximity to the sea or of concentration by evaporation under desert conditions or of volcanic activity or from other causes. In contrast to this *Aëdes durbanensis*, while possessing larval characters typical of brackish water species and a largely coastal distribution, has never been found breeding in anything but " fresh " water (Mattingly, 1954 : 59). Intermediate between these extremes (if such they are) is *Aëdes caballus* which, in the northern part of its range (Eritrea) is found breeding mainly near the coast and in waters containing up to 4% chloride while in the Transvaal it occurs in depressions in the veldt temporarily filled with rain or irrigation water. In the latter case, particularly where rain water is concerned, it must be presumed that the breeding waters are genuinely fresh. To complete the picture it may be said that the type form of *Aë. hirsutus* has been found breeding mainly in temporary ground pools, after heavy rain, while the same is true of *Aë. arabiensis* in the Sudan although in Arabia it has been specifically recorded only from one of the tanks near Aden in company with *Aë. vittatus* (Patton, 1905 : 634 ; Hop-

* Professor Callot has informed us (*in litt.*) that *Aë. caspius* is quite often found in flooded meadows in Alsace in association with *Aë. vexans*. This is interesting because the same two species were found associated in a recent inland outbreak at Morden near London. *Aë. vexans* is a rare and very local mosquito in Britain, but this is one area in which it has been known for some time to be established.

kins, 1952 : 198). It is possible that it may share the preferred breeding-places of the latter species (rock holes) or it may resemble *Ae. hirsutus* in preferring pools in softer ground. The remarkable adaptation of *Aë. vittatus* to torrential conditions in central Spain had been noted above (p. 133) and it is possible that similar, at first sight surprising, adaptations may be found in other ground pool breeding Arabian *Aëdes*. Summarizing this group it may be said that several of the species are linked by their tolerance for high mineral salt contents in their breeding waters while most, if not all, possess in a marked degree the capacity for utilizing temporary breeding-places. The latter capacity argues, on the one hand, a tolerance of high temperatures in the breeding water and, on the other, a rapid larval development keeping pace with the equally rapid drying-up of the breeding places. This last has been specifically noted only for *Aëdes arabiensis* and *hirsutus* (Hopkins, 1952 : 198, 252), but it probably applies also in varying degrees to the other Arabian species. Finally, as an example of one further aspect of the distribution of desert mosquitoes, reference must be made to the remarkable case of *Culex arbieeni*. This species is known only from four localities which are very widely separated indeed and which lie at the four corners of a quadrilateral roughly embracing the Sahara desert. These localities are the island of Teneriffe (Canary Islands), the southern part of the Sinai Peninsula (Wadi Arbieen and Wadi Feiran, near Mt. St. Catherine), the Yemen and the Jebel Marra in the south-western Anglo-Egyptian Sudan. One point of interest about these records is that all are from areas of intense and relatively recent volcanic activity. No measurements of the mineral content of the breeding waters have been published and there is no reason to doubt that this species possesses the capacity to breed in fresh water. Nevertheless it is difficult to believe that it did not originally evolve as a plutonic species. The second point of interest concerns the extreme geographical discontinuity of the records coupled with the fact that, apart from certain differences in the mesonotal scaling, a very variable feature in *Culex*, there is little in the available material to indicate subspeciation. This suggests that the four populations may not have been very long isolated from one another, which would imply that the present rigorous desert conditions pertaining over much of the Sahara may be of relatively recent origin. For this there is much other evidence (see numerous papers by Joleaud, e.g. Joleaud, 1938). A comparable case is perhaps that of *C. univittatus* of which the Mediterranean form (var. *perexiguus* Theobald) occurs as far south as the Zaria area in Nigeria and may well be thought to have crossed the Sahara in comparatively recent times (Mattingly, 1954 : 56).

The last group of species to which reference will be made comprises the domestic and peridomestic species which are particularly closely associated with Man. *Culex nebulosus* and *Culex duttoni* have already been noted as belonging to this category (pp. 101, 102). Since they are known only from a single locality little can be said about them except that if they occur in Arabia at all it is surprising that they do not occur more widely. It seems possible that they may represent recent human introductions, perhaps by air, and it will be interesting to see whether they are recorded more frequently in future. Regarding *Aëdes aegypti* it has already been noted that this occurs in Arabia, as in many other parts of its range, as two distinct forms, the pale type form, originally described from Egypt, and a darker form, jet black over

most of Africa south of the Sahara, tending to be somewhat browner elsewhere, which is frequently, but erroneously, referred to as the type form. In Africa south of the Sahara the pale form is almost entirely coastal in its distribution with very limited penetrations inland along a few major lines of communication, and it is therefore considered to be an introduced form (Mattingly, 1953*a* : 46). It occurs to an unspecified extent in India (Barraud, 1934 : 222, 223) and Mr. Donald Colless has reported to us the occurrence of a very pale island population near Singapore. It is also known from northern Australia. Where the two forms come into contact, as in coastal regions in Africa, every degree of intergradation is encountered, strongly suggesting the occurrence of hybridization. Intermediates of this type, as well as fully pale forms, appear to occur in the West Indies and, very extensively, in the southern United States. The whole subject of the distribution of these forms is at present being studied and it is too soon to form a definite opinion, but the indications so far would not be inconsistent with a hypothesis that the natural range of the pale form is in Arabia, or perhaps the southern part of the Mediterranean Sub-region in general. It may or may not have had a natural extension into the Somalilands and it must certainly have been introduced by Arabs into coastal regions of East Africa at a comparatively early date. Extension of its range into West Africa may have come later. It may have been carried to the New World and to Australia and the Far East in the hybrid form. It is apparently more highly domestic than the dark form (Mattingly, 1955*a*) and its marriage with the latter may have been a factor of some importance in the history of urban yellow fever. The comparative bionomics of the two forms is, however, a subject requiring much further study, as indeed do all questions involving the genetics of behaviour in mosquitoes.

From a practical point of view the coexistence of pale and dark forms in a locality such as Mombasa (Teesdale, 1955) raises formidable problems of control, and it is plain that these can only be tackled on a rational basis in the light of studies on the genetics of the hybridizing populations. In recent genetical studies on *Aëdes aegypti* (Gillett, 1955*a*, *b*) there is reason to suspect that one of the strains employed may have been a pale-dark hybrid and this is a possibility which needs to be taken into account in all genetical work on this species. Genetical diversity between the strains employed is also indicated by the failure of Indian *Aë. aegypti* to cross with Indochinese *Aë. albopictus* with which Indochinese *Aë. aegypti* were known to be compatible (Toumanoff 1939). It is evident that in the past our approach to this important species has been altogether too naïve.

The same is true of the other principle culicine disease vector of Arabia, *Culex pipiens fatigans*. The question of hybridization between this subspecies and *C. p. pipiens* has been discussed above (pp. 102, 133) but it should also be noted that even within ssp *fatigans* there exists considerable divergence in Africa. Thus the East African Lowland form of *fatigans*, which the Arabian form may be tentatively supposed to resemble, is extremely abundant and widespread and bites Man avidly. The form found in certain parts of West Africa, on the other hand, is a rare mosquito, largely confined to the immediate vicinity of the ports, and, in general, will not bite Man at all. It is clear that this is an introduced form, though its origins are unknown. It will be evident that facts such as this will need to be taken into account in plan-

ning the control of this important pest—a difficult matter at the best of times, since it is, of all mosquitoes, perhaps the most resistant to D.D.T.

In conclusion a word may be said with regard to *Culex sitiens*. This is not strictly a domestic mosquito but it is closely associated with man, particularly in his travels, by reason of its ability to breed in highly brackish water in such places as the bottoms of boats and canoes. Its range has undoubtedly been considerably extended by human intervention and, since it is almost entirely coastal in its distribution throughout the tropics, there is little indication as to what its original distribution may have been. The British Museum has, however, some specimens of a very interesting inland population from Bandan in Seistan (eastern Iran) nearly 400 miles from the sea. The occurrence of *C. sitiens* so far inland suggests rather strongly that this may be its natural area of distribution and that it may have spread eastwards and westwa ds along the coasts from here. Similar arguments have been adduced by Mattingly (1953*a* : 46) with respect to the pale form of *Aëdes aegypti* in Africa, Reid (1954) with respect to the (mainly) dark form of this species in Malaya and Edwards (1941 : 299) with respect to *Culex tritaeniorhynchus* in Africa, each of these forms being postulated as a human introduction on the basis of its wholly or largely coastal distribution.

SUMMARY

A careful revision of existing material and records has led us to recognize 42 species of mosquitoes as occurring in the Arabian area. Three of these, *Anopheles demeilloni*, *Aedes caballus* and *Culex duttoni* are here recorded for the first time from Arabia. *Anopheles coustani* is represented both by the type form and a variety. *Culex univittatus* is also probably represented by at least two forms although this cannot be definitely established on the basis of the available material. *Aëdes aegypti* is represented both by the pale type form and by the dark form although the latter appears to be comparatively rare. Two species of *Anopheles* (*An. hyrcanus* and *An. subpictus*) have been recorded from the area but are omitted from our list as their presence has not, in our opinion, been conclusively proved. *Anopheles adenensis*, *macmahoni* and *rupicolus* are reduced to the status of subspecies of *Anopheles culicifacies*, *sergenti* and *rhodesiensis* respectively and *Anopheles arabicus* is relegated to the synonymy of *Anopheles fluviatilis*. The type of *Culex arabicus* Becker has been found on examination to be a specimen of *Aëdes caspius*. It is noted that the larva currently attributed to *Aëdes minutus* is in fact *Aëdes vittatus* and that records of *Culex thalassius* from Socotra are, in our view, erroneous. Keys for the identification of adults and fourth stage larvae are presented and in these we have included *An. hyrcanus* and *An. subpictus* as well as the important malaria vector *Anopheles superpictus*, which we consider will almost certainly occur in northern Arabia although it has not so far been recorded from there. *Anopheles hispaniola*, although not as yet recorded, may well be found in north-western Saudi Arabia. We have not included it in our keys since it is very difficult to separate from *Anopheles cinereus* and, in our opinion, a detailed comparative study of these two species is required. *An. hispaniola* has been synonymized by some authors with *An. turkhudi*, but there can be no doubt

that it is more closely related to *An. cinereus*. A number of species occur both in India and in tropical Africa although they are apparently absent from Arabia. In our view most of these are probably excluded by unfavourable climatic conditions although one or two may still await discovery. We have listed a number of Palaearctic species which may yet be found. The bulk of the Arabian mosquito fauna is Palaearctic although there is a considerable Ethiopian element in the south-west which amply justifies the inclusion of this part of Arabia in the Ethiopian Region. The mosquito fauna of Socotra, on the other hand, is, in our opinion, predominantly Palaearctic. The Oriental element in the Arabian fauna is extremely small and appears to be almost entirely coastal, although our complete ignorance of the fauna of the mountains of Oman and the Qara Mountains in Dhufar does not permit us to say to what degree it may extend inland in those areas. Certain distributions are discussed in detail and an account is given of a remarkable instance of clinal variation in *Aëdes caspius* and of convergence in larval characters as between *Aëdes vittatus* and *Aëdes arabiensis*. The distribution of these and other ground-pool breeding *Aëdes* is discussed in relation to geological factors. The interrelationship between desert, brackish water and plutonic species appears to be subtle and suggests some interesting studies in desert biology. The widely discontinuous distribution of *Culex arbieeni* is cited as suggesting considerable amelioration in the recent past of the conditions at present prevailing in the Sahara desert. The distribution of various species is discussed in relation to altitude which, in Arabia, is so closely bound up with rainfall that variations in the latter may well override in importance the usual temperature gradients. Behaviour differences as between the pale and dark forms of *Aëdes aegypti* are cited as exemplifying the need for genetical studies on the common domestic mosquitoes.

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